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A CAMEL JOURNEY TO TIBESTI

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In accordance with a recent decision of the P.C.G.N. native names in French territory are here spelled as on the French official map, Croquis de l'Afrique Française au Millionième, and those in Italian territory as on the map of the Ministero delle Colonie, 1/3 M. Serviz. Cart. N. 729, 1937.

THE magnificent mountains of Tibesti are in the Colony of Tchad in French Equatorial Africa, on the frontier of Italian Libya to the south-west of the oases of Cufra. They extend approximately 200 miles from north to south, and 250 from east to west, and contain by far the highest summits in the Sahara. Emi Koussi is 11,200 feet in height, Toussidé, 150 miles away, is 10,700 feet high, and Ehi Timi or Ti nearby is 9970 feet high. Tiéroko, the most magnificent of all the Tibesti mountains, Ehi Mousgou, Tarso Toon, and numerous other peaks are but little short of these in height. Tibesti is surrounded by desert. To the north and east is the waste of the Libyan sands, to the west the vast emptiness of the Sahara, while to the south the barren dunes extend from Borkou to Kanem and Ouadaï. These mountains are the home of the Tibbu, a hardy race of Libyan origin who ranked amongst the most redoubtable raiders in Africa. The French forces under Colonel Largeau conquered the large oases of Borkou from the Senussi in 1913, and from this base Tibesti was explored during the following years by Lieutenant-Colonel Tilho.[1] Before the occupation of Borkou, posts had been established from Bilma at Bardaï in the north-west of Tibesti and at Zouar on the north-western edge of the massif, but these were evacuated owing to the Tuareg revolt in Aïr in 1916, and the French did not again occupy the mountains until the Italians had captured Cufra in 1930. But various military expeditions, of which that under Lieutenant-Colonel Tilho in 1925 was the most important, mapped and explored the country. The arrival of large armed bands of fugitive Fezzan Arabs, traditional foes of the Tibbu, and the fear of

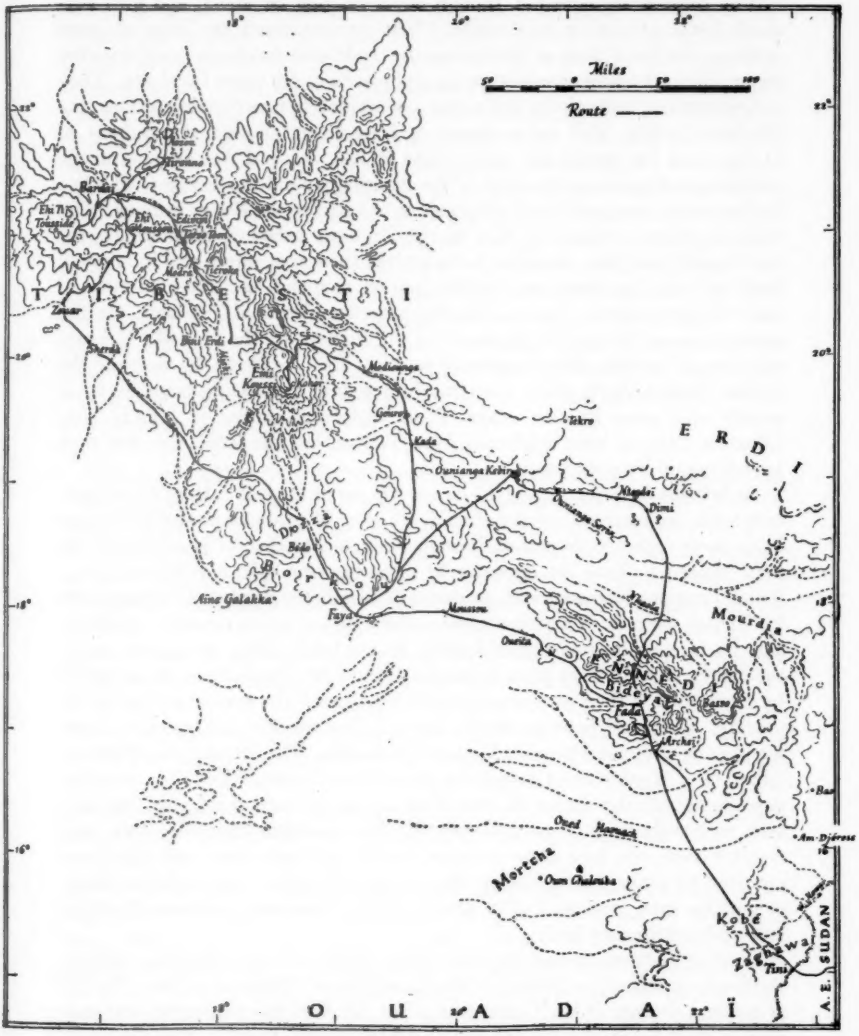
[1] A description by Colonel Tilho of his explorations in Tibesti, Erdi, Borkou, and Ennedi is to be found in the *Journal* (56 (1920) 81–99, 161–83, 241–67).

Italian penetration led to the establishment of a number of new posts in the mountains. Tibesti has however remained all but unvisited and unknown to the outside world.

The wish to visit Tibesti had grown strongly on me during the three years that I had served in northern Darfur, and I decided to spend my 1938 leave in travelling among these mountains. I left Tini on the Darfur–Ouadaï frontier on 3 August 1938. I had hired camels to take me as far as Borkou, after which it would be necessary to use Tibbu camels accustomed to travelling among the mountains. Besides the Zaghawa who accompanied these camels, I had with me Idris Daud, a Zaghawi lad of the Kobé tribe who had been with me for the past three years, and an elderly Bideyi named Khatir, who knew the Tibbu tongue, having lived among these tribes as a boy. We travelled light, the distances before us being great and the time at our disposal short. We carried flour, sufficient to last us for three months, from which to make the *assida* or flour paste on which we lived, dried meat, onions, and "ladies fingers," for the *mulah* or seasoning, and a sufficiency of sugar and tea. We had no kit other than our rifles, sheepskins, blankets, and a small tent. We entered a country of stony plateaux covered with scattered thorn bush, of rocky hills and well-wooded watercourses belonging to the Nawra section of the Kobé Zaghawa. The Kobé are a powerful tribe of semi-sedentaries owning large herds of cattle and many horses. Their villages were generally placed on the summits of rocky hills. We were hospitably received by these people, who were Idris's kinsmen. Then crossing the Oued Haouach we entered Bideyat territory and marched along under the western edge of the Ennedi mountains, which rise to a height of 5000 feet.

The Bideyat know these mountains by a number of different and local names. The collective name of Ennedi is used only by the French. Ennedi consists of a number of plateaux, intersected by numerous precipitous-sided wadis, and there appeared to be no outstanding peaks. The tableland itself was stony and devoid of vegetation, whereas the sandy wadi beds contained numerous trees, principally acacias amongst which were some fine *heraz* trees. The cliffs were much eroded and there were many detached bastions of rock among the dunes, several of which were of fantastic shapes. There is a small annual rainfall among the mountains, and the water is caught in rock pools often hidden at the back of deep fissures in the cliffs. The knowledge of such pools is carefully guarded by the Bideyat. There are also a few springs such as those at Archeï, a short distance to the south of Fada. Here is a string of deep but narrow pools at the end of a winding valley closely shut in between sheer walls of rock. There are no reeds nor other vegetation. Basking on the edge of these pools I saw six small crocodiles, the largest 5 feet in length. The many shoals of small fish provide them with a sufficiency of food. Nearby is a large cave at the back of which are many small stalagmites. There are some interesting rock-pictures in different colours in this cave. I found another and more varied series in some small caves in the Wadi Tuku, which showed great variation in conception and execution. Many of these drawings, of which I copied a large number, were of considerable artistic merit. The plateaux walls were often honeycombed with caves and grottoes, and several of them were decorated with rock-pictures. These portrayed hunting scenes,

horsemen, a few camels, long-horned piebald cattle, and both clothed and naked figures. Some of these drawings closely resembled those previously



Sketch-map to illustrate Mr. Thesiger's journey to Tibesti, 1938

known from 'Uweinat and the Ahaggar (Hoggar) mountains. Whereas the drawings I found in Tibesti were petroglyphs, with the exception of some painted figures under an overhang near the Bardaï–Aozou road, all those I found in Ennedi were painted. The Bideyat told me that these rock-pictures

were especially common in the Basso in the heart of Ennedi, round whose southern and western sides they principally live.

The Bideyat are nomadic, though never ranging far afield, and own fair-sized herds of camels and cattle. Their encampments are huts of grass matting, similar to those of the Goraan, or crude shelters of grass and branches woven through a framework of sticks, and placed under a tree for shade. They call themselves collectively Toba, and are divided into two main sections, the Birriera-Kureira, who on occasions at least have followed the Sultans of Darfur, and live round the well centres of Baô, Ito, and Am Djéress on the southern and south-eastern edge of the mountains; and the Boragat, who live farther to the west and owed allegiance in the past to the Borgu Sultans. The Bideyat dialect is similar to that of the Zaghawa tribes of northern Darfur and Ouadaï, and they resemble them both in their appearance and in many of their customs; but they are a wilder, hardier race and have retained more of their old pre-Islamic customs than the more sophisticated Zaghawa. On the eastern edge of Ennedi to the north of the Birriera are the Mourdia Goraan, who extend up into the inhospitable waste of Erdi, while to the west are the Gaida Goraan. Both tribes are entirely nomadic, possessing large herds of camels and goats but no cattle. Their dialect is similar to Tibbu. The Mourdia claim to have originated from Tibesti, but the Gaida say that they have come up from the south.

Fada is the headquarters of the *circonscription* of Ennedi. Here I was most hospitably entertained by the French officers. Two sections of the Groupe Nomade or camel corps passed through Fada the day that I arrived, and I was very pleased to have the opportunity of seeing this splendid body of men. These Groupes Nomades are composed of Tirailleurs Sénégalais commanded by French officers. They live continuously under active service conditions and are in consequence extraordinarily fit and hard. They remain far out in the desert, moving from place to place continuously. Few places are unvisited by them, though their movements naturally depend to a certain extent on the grazing. They delight especially in choosing inaccessible and waterless spots for liaisons with neighbouring Groupes Nomades. The life of these officers is a hard one. It takes three months to arrive from France. They then serve for two years, with the choice of extending the period for a third year, before a visit to France and transfer elsewhere. The Groupes Nomades trek in a country harsh and bare in the extreme, and though they carry tents they have no camp kit other than a folding office table and chair. Despite its hardness, or perhaps even as a result of it, all the officers I met were enthusiastically in love with the life they lead.

Leaving Fada we crossed the intervening desert to Faya in Borkou, which is the headquarters of the Borkou, Tibesti, and Ennedi administrations. We had as guide a Gorani of the Gaida tribe. For the first day we wound our way among great bergs of rock 400–500 feet high rising abruptly from the sand. Wild sheep were not uncommon and watched, high up on the bare faces of rock. We watered at the three oases of Oueïta, Oudé, and Moussou; shallow depressions in the sand where water, much of it brackish, lay close to the surface and *sivack* bushes and small long-suffering acacias were abundant. They were on the regular caravan route from Borkou to Ouadaï and Darfur,

and in consequence the bushes had been grazed bare, so that my camels wandered disconsolate from one to the other, weak from lack of food. Anxious to save them as much as possible we marched much by night, for the sun was burning hot by day. Near Moussou a sandstorm swept down upon us as we lay among the dunes, waiting for the moon to rise, and lasted for two hours. Wrapped in our tobes we crouched against the camels beset by a curious and uncomfortable feeling of isolation as the storm howled by. When it had passed the accumulated weight of sand had squeezed all but a drop of water out of our skins. After two hours' marching the guide, confused by the overcast sky, confessed his sense of direction was gone and pointed S.S.E. for north. Almost without water and doubting if the camels would stand another full day in the sun, I took the lead with my compass. Soon after dawn the guide recognized to our relief some rocks which lay not far from Moussou. We had a last march of twenty hours to the edge of the palm groves of Borkou. A grey dawn found us on an empty plain of hard sand across which swept scuds of rain, chilling and dispiriting; having no wood we were unable to cheer ourselves with the customary three glasses of sweet tea. We trudged along short-tempered and apart, until at midday we reached the first of the palms. Here we rested, entering Faya next day.

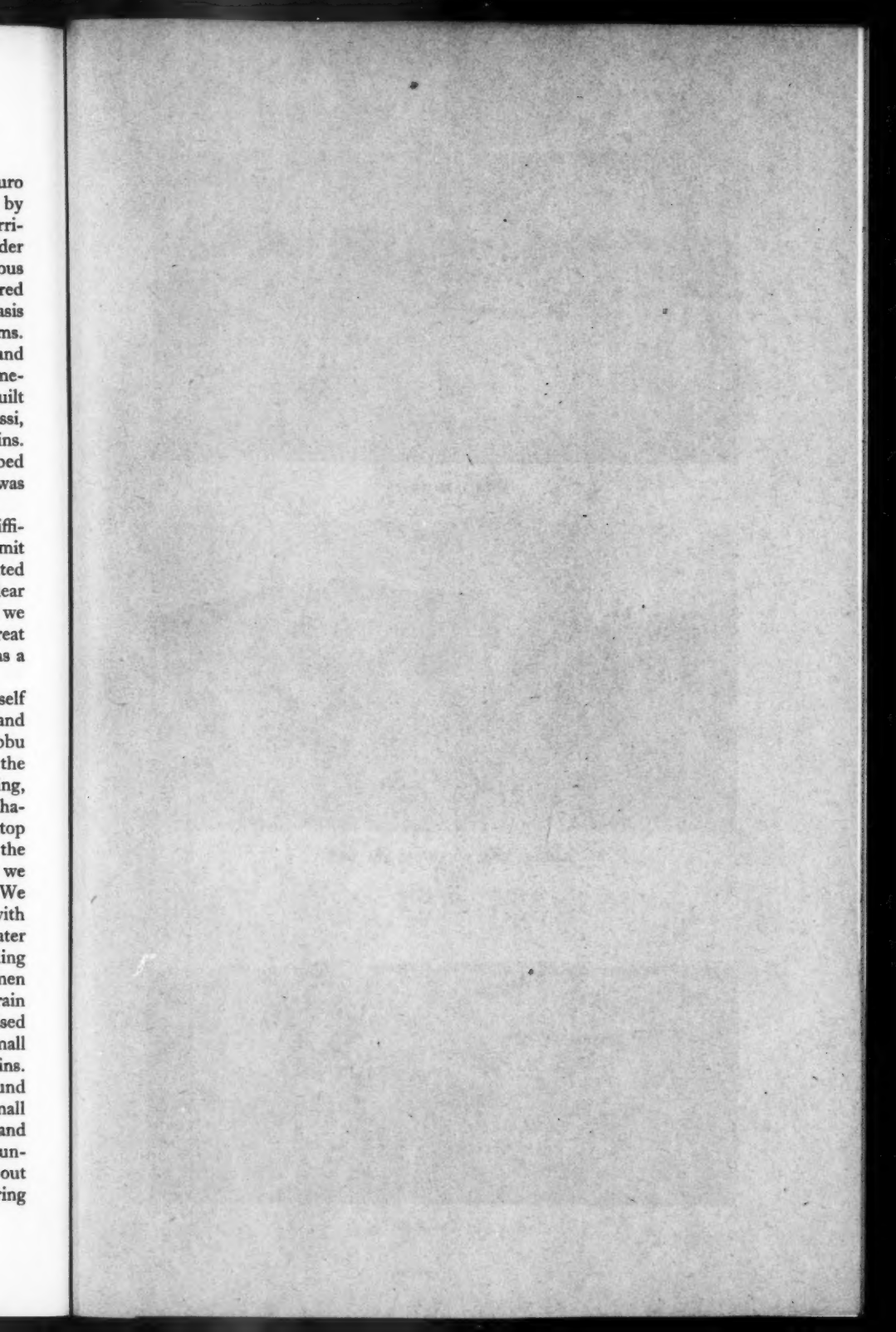
Faya is a small but attractive Saharan town surrounded by palm groves. These extend almost without a break to Aïne Galakka, 50 miles to the west, which was the Senussi headquarters in Borkou until the French captured the fortress in 1913 after severe fighting. In Faya there are numerous gardens, many of them adjoining the houses, and some good vineyards and fig trees. For though rain is all but unknown here, water is abundant and can be found almost anywhere in this depression at 3–5 feet. Trade is in the hands of the Fezzan Arabs, who have been considerably increased by refugees from Italian territory. The permanent sedentary population of Borkou numbers about 4000 and consists of the Dozza and their serfs, who are known as Kamadjia. The population goes up to 20,000 in July and August when the tribes come in for the date harvest, while caravans of Mahamid Arabs with as many as 1500 camels come up from the south. The Anakazza, who resemble the Gaida in speech and mode of life, live in the deserts of the Mortcha to the south-east, extending as far south as Oum Chalouba. I encountered but few of this tribe on the outskirts of Borkou.

The French officers entertained me most hospitably for the two days that I was in Faya, and assisted me to find suitable camels to take up into the mountains. The camels of the mountain Tibbu are small, lightly built, long-legged, reddish in colour, and as active as goats. We marched north to Gouro, where we arrived in four days. The track passed through a waste of volcanic rocks half buried in the sand, and we marched fast in order to leave it behind us. This did not accord with the views of the two Tibbu who accompanied us. One of them, a young man named Ibrahim, soon earned for himself the nickname of "Abu Shekwa," or The Father of Complaints; yet his grumbles hid a ready laugh, and his endurance was our envy. Starting in the early afternoon, we made a forced march of twenty hours across the worst of this shadeless blazing desert to Kada wells near Gouro. When dawn broke I saw, faint

like a cloud upon the desert's edge, the dim outline of Emi Koussi. At Gouro there is a grove of date palms and small fresh-water marshes, ringed in by black walls of rock against which the sand has drifted deep. This is the territory of the Arna tribe whose chief Adam Nater-Mi won great fame as a raider and an outlaw before finally submitting to the French. His even more famous brother Muhammad Arbei-Mi died recently in Kordofan, having preferred exile in the Sudan to submission. Many of the tribe had come in to the oasis to collect their dates and were camped upon the sands round the palms. Their huts were built of mats laid over a framework of sticks, oval in plan and 5–8 yards long. When moving the Tibbu frequently leave behind the framework against their return in the following year. The small French fort is built upon the site of the former stronghold of Said Muhammad El-Senussi, generally known as Sidi El-Mahdi, of which however scarcely a trace remains. Nearby is his tomb, a small square whitewashed building, containing his bed draped in white cloth, and a few ostrich eggs hanging from the ceiling. It was built by the French in place of the original tomb which they destroyed.

Neither of my Tibbu knew the tracks on Emi Koussi, and after some difficulty I found an elderly Tibbu, named Kuri, who had been to the summit thirteen years before. We went north to the wells of Modiounga, dominated even from a distance by the great humped-back mass of Emi Koussi, a clear sharp blue at dawn, but deep purple against the setting sun. From there we climbed with difficulty on to the rocky sun-scorched tableland, riven by great gorges descending from the mountain range to which this tableland forms a base. All life was absent here; even the camel flies had left us.

At the foot of the mountains we separated. Idris, Khatir, Kuri, and myself with the two best camels turned south to work back along the mountains and up on to the summit of Emi Koussi, while Ibrahim and the other Tibbu crossed over with the remaining camels by an easier and direct pass into the valley of the Miski. We struggled along, alternately climbing and descending, but slowly working upwards, until we came to the great gorge of the Mashakezey, 1000 feet or more in depth and so sheer that a stone flung from the top fell clear. A faint track marked with donkey droppings disappeared over the edge. Somehow the camels went protesting down that winding path, while we lay back on tails and saddle ropes, and loosened boulders crashed ahead. We reached the farther side at sunset, our camels trembling and exhausted with the effort, and camped among a number of prehistoric stone circles. We later passed several similar sites, some of them extensive; great boulders, marking rough walls and circles upon a level space. Built by the giants of old, my men declared, for who could shift such stones to-day? Here a light shower of rain had recently fallen and pools were still lying among the rocks. I was surprised to find in one such pool, perhaps 2 feet across and 6 inches deep, a few small fish, half an inch long, silvery in colour, with crimson tails and back fins. During this night we were troubled by mosquitoes. Next morning Kuri found fresh camel tracks and a small Tibbu camp nearby, where a woman and small child herded two camels and a flock of goats. She lent us her two camels and brought us a small bowl of milk which must have been her all. These mountain Tibbu live in caves, or in crude unroofed stone circles, while they eke out a livelihood with their small herds of goats and an occasional camel, enduring



Tibbu mat huts

Inside the crater on Emi Koussi

The Faya–Gouro road

The Modra valley

Lake Yoa, Ounianga

Petroglyphs in northern Tibesti

extreme hardships of hunger and cold. No rain had fallen for two years, and this was not exceptional. During the worst times the goats are kept alive on crushed date stones, and the camels on a handful of dates.

We reached the mountain top above and camped. To the north there was an awe-inspiring view out across range upon range of mountains and jagged peaks, rising from precipitous shadow-filled gorges. To the west, beyond the valley of the Miski, a yellow streak far below, were other mountains; while to the east was the expanse of sand. The shoulder of Emi Koussi shut out the view behind. Towards evening the air turned bitterly cold, and the mountains stood out dark purple and very clear, under massed banks of cloud, molten in the sunset. Next day, after several failures, for Kuri's knowledge of the path proved vague, we found a way down into the great crater on the summit of Emi Koussi. This crater is 8 miles long and 5 miles across and appeared as an extensive plain rimmed with mountains, for the crater walls at their highest point are 1300 feet above the level of the plain. On the north the crater wall falls in two steps to the plain below. The plain is very stony and is sparsely covered with a heath-like plant some 2 feet in height, useless as camel fodder but valuable as fuel.

We camped that night under a small hill close to the great vent of Kohor, which lies towards the southern edge of the crater. It was again bitterly cold. Next morning we climbed down into Kohor, the bottom of which is covered with a deposit of a sodium salt and ashes more than 3 feet in depth. This huge hole is 1000 feet deep and perhaps 2 miles across at its widest part. Its sides are abruptly precipitous, except to the north, where there are steep screes under a small cliff. Idris and I then climbed to the summit of the southern wall of the crater, thus attaining the highest point in Tibesti. The day, unfortunately, was hazy, owing to the very strong wind which was blowing, but nevertheless the view was magnificent. It was very cold on the summit even at midday. We saw a wild sheep, and found the droppings and tracks of several others under ledges of rock. We had that morning noticed the tracks of many wild sheep round the lip of Kohor. The Tibbu snare them with noose and drag log, for amongst them trapping game is not confined to the outcast community of blacksmiths as among the Zaghawa. Then returning to our camp we loaded the camels, and climbed back out of the crater by an easy track, for which Kuri had searched in vain the day before. We went down again to the Tibbu encampment and fetched our own camels. Kuri, who was more than uncertain of the way, persuaded the woman to accompany us to the Miski. She strode ahead of us, a wild and impressive figure, with a naked knife in one hand and an oryx horn in the other. After crossing another gorge we descended at last into the valley of the Miski. Here I found a few crude petroglyphs hammered on the rock. Later in the Bardage and on the road to Aozou I found many others. Some were hammered, while others were cut, broad and deep, in the hard rock. Human figures, many of whom wore three-feathered headdresses, numerous cows, a few stereotyped camels, two large addax, and an elephant were represented. Several showed a great similarity to those discovered by Mr. Francis Rodd in Aïr. The largest, that of a cow, was 11 feet in length. In Tibesti I found but one set of drawings in colour, of tailed figures one of whom carried a double-bended bow. These figures were drawn

with considerable skill, but had been much damaged by the weather. They were of the bushman type.

Ibrahim had found us two Tibbu with six fresh camels from the Tika tribe, many of whose mat huts were scattered among the acacias round the wells of Bini Erdi. One of them was a lad called Dadi, a nephew of the Tika chief Abd el-Qader. The camels were lovely animals. Dark in colour and heavy in build they were of the lowland type and promised great reserves of strength. The Miski contains the best camel-grazing in Tibesti, but the bushes are *siwack*, to eat their fill of which camels must be watered daily. Dorcas gazelle were common here, and I shot several, for meat is a great luxury to these people. We then held a farewell feast for Ibrahim and Kuri which the local Tibbu attended in force. One boy who helped us to prepare the meal was prevented from eating it by the unwelcome appearance of his stepfather, since it was contrary to tribal custom for them to feed together. Three days later we reached the Modra valley and camped under the pass in a small terraced village halfway up the mountain side. The precipitous face of rock above was crowned by a clump of palms which leant out precariously over it. From the village we looked across at Tiéroko, looming over the 1000 feet of unbroken precipice which enclosed the valley at our feet, where a small swift stream ran through bulrushes among palms and gardens, sweet-scented with sage. The village headman was away, but his two sons, small boys of great beauty, brought us food, sweet stoneless dates and *assida* seasoned with curdled milk. That night the moon was full and lit up Tiéroko, filling the misty gorge below with shifting lights and shades. The music of falling waters rose up to us in the stillness of the night. In the morning we climbed the pass, and crossed a desolate stony tableland where the wind blew in tearing gusts. Then after skirting Tarso Toon we descended into the Zoumorie at the small oasis of Edimpi.

Among the barren mountains of Tibesti the Tibbu are dependent on the dates from the oases for their means of life, and of these the oases in the Bardage, the Zoumorie, and Aozou are by far the most important. In the Bardage there are some 30,000 palms in fifteen oases, while in the Zoumorie there are perhaps 7000 palms in fourteen oases. Tibesti is believed to produce 2000 tons of dates in a good year, half from the Bardage and a quarter from the Zoumorie and Aozou. But this does not suffice the needs of the Tibbu, who seek more dates from Borkou, Taisser, and el-Gatrún in exchange for tomatoes, butter, and goats. In most of the oases there are springs of water, reed beds, and small gardens watered with *shadufs*. There are permanent villages and a small sedentary population, vastly augmented from June to September by the surrounding Tibbu who come in off the mountains for the date harvest. The small round houses are built of stones set in mud and thatched with rushes. All the date palms are individually owned, as are even the dom palms, the fruit of which, crushed into flour, is eaten by those who lack a sufficiency of dates. In their gardens they grow a little wheat, barley, maize, rye, millet, red pepper, and tobacco, and a few melons and tomatoes. But these gardens are very small and less numerous than of old. In the past they were tended by slaves, many of whom have now been liberated, and most

Tibbu will not degrade themselves by working on the soil, for though to own a garden is a sign of riches, to work in one is accounted proof of servile origin. They say that they are too few to tend both their herds and their gardens and that they prefer the harder but traditional life of the herdsman. All own a few goats, while those who are rich own several hundreds. To possess a camel is a sign of wealth, to own fifty is to be extremely wealthy. The camels of the Miski valley and of the western foothills round Zouar are dark in colour and heavy in build, resembling those of the Mourdia Goraan, and are very much more numerous than the small mountain camels. The Tibbu possess too some Tuareg and Fezzan camels, many of these the spoils of former raids. There are a few sheep in the valleys. Donkeys are extensively used, and many have run wild among the mountains probably for generations.

The French are much concerned about the future of these mountain folk. There seems to be little doubt that the desiccation of the whole area increases yearly. The failure of the rains has been especially pronounced since 1914. Within living memory the valleys on the northern slopes of the central Tarsos contained good pasturage and were thickly populated. To-day they are barren and deserted. The French are apprehensive that with no more fear of raids the Tibbu will drift away south to the Miski, the Maro, and towards Borkou, or north to el-Gatrún and Múrzuch, unless they can be anchored to their gardens. Yet these tend yearly to decrease. The Tibbu show as yet few signs of taking to a sedentary life. In the past they have been nomads and raiders by force of circumstances and by inclination. It remains to be seen if they will now become sedentary by force of circumstances if not by inclination.

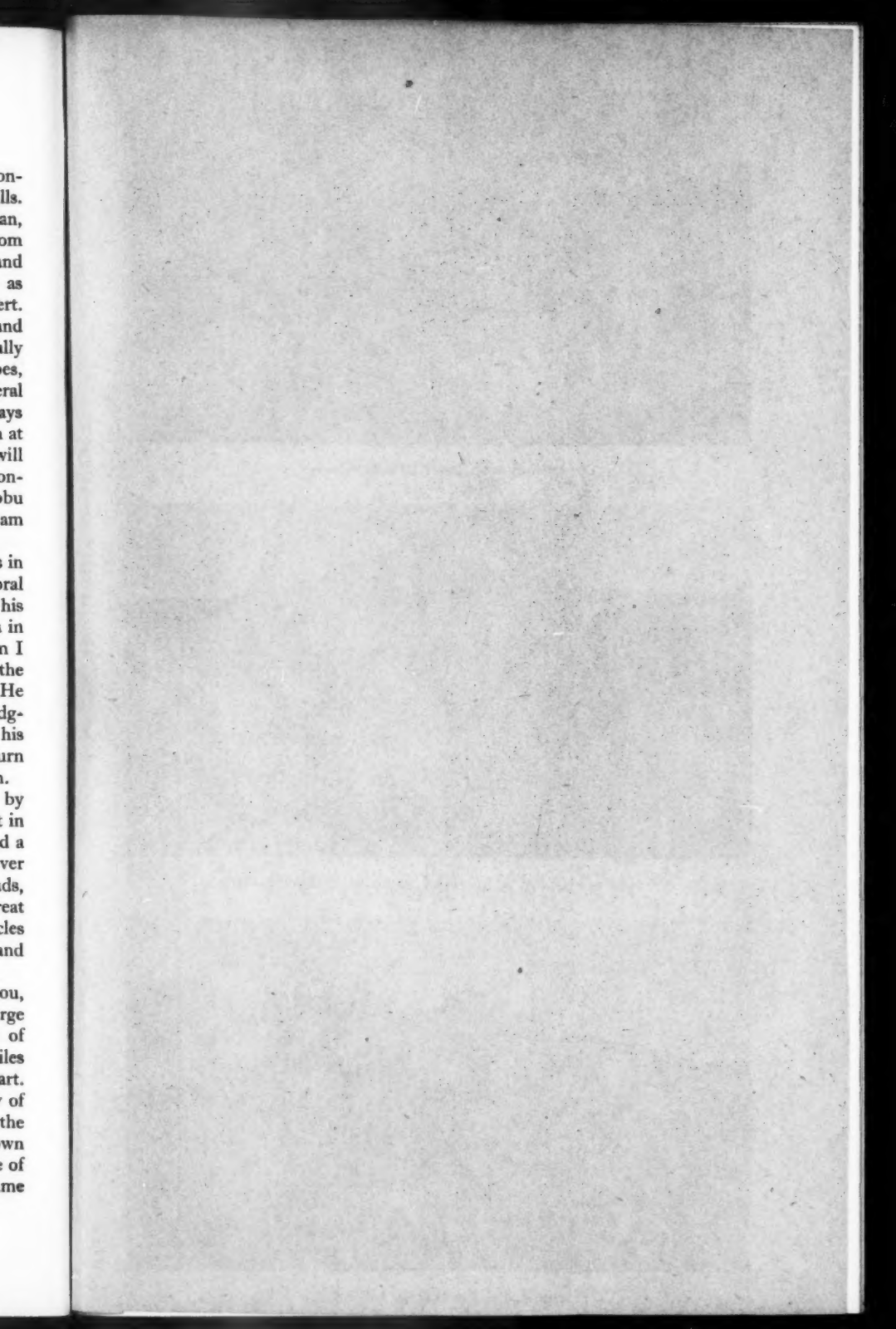
They refer to themselves as Tedda, and to Tibesti as Tu; Tibbu and Tibesti being the names by which the Fezzan Arabs know these people and their country. They can probably be identified with the Garamantes of Herodotus and Ptolemy who hunted the troglodyte Ethiopians in four-horse chariots, and lived somewhere between Tripolitima and the Fezzan. Pushed south, they sought refuge in the inaccessible mountains of Tibesti, which may be looked on as the cradle of the Tibbu race. They are certainly related to the Bideyat and Zaghawa of the south-east, though they do not understand the common language of these tribes. It is generally agreed that they are largely of Libyan origin, and that there is a gradual merging into the negroid populations of the central Sudan through the Dozza Bideyat and Zaghawa, the last of whom to-day possess many negroid characteristics. The Tibbu vary considerably in colour. Many are little darker than the Fezzan Arabs, while others are very dark but never black. Their features show no negroid characteristics. They are in general small and sparse in build and possessed of great powers of endurance, especially on foot. Their staple food is dates. Flour, sour milk, and butter are luxuries, and milk is scarce except when the rains are good, and is usually kept for the small children. Meat is rarely eaten except at Eid el-Kebir and at festivals of marriage and circumcision. The men wear a loose white jibba with voluminous sleeves over which the wealthy wear a black cloak lined with red or a blue cloth decorated with gold thread. Almost invariably they wrap the end of the turban across mouth and nose, so that they appear veiled. Their weapons are a throwing spear, barbed both ways, a long arm knife, which every Tibbu wears, and a few throwing knives and crude iron

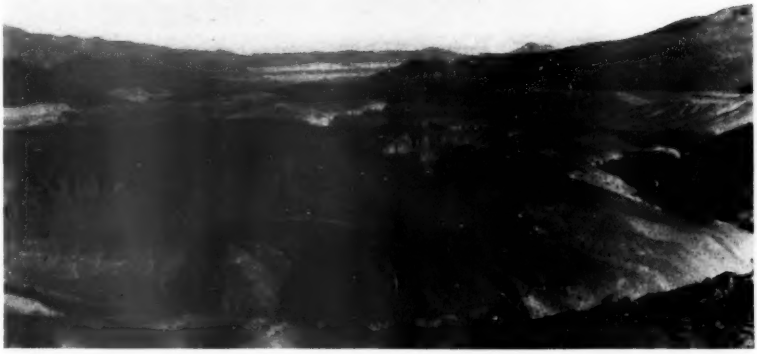
swords. In the past they possessed numerous rifles, but these have been confiscated by the French, though a few are probably still hidden in the hills. The French never met with serious opposition from the Tibbu and Goraan, such as they encountered from the Senussi. Essentially individualists, whom no chief in the past has effectively controlled, they have never combined and have always been much divided by blood-feuds. Their great fame was as raiders, and they can have had few equals for their knowledge of the desert. They raided to Aïr, into the Fezzan, and east as far as the Nile valley, and harried the rich lands to the south beyond the desert. Camel theft is virtually unknown amongst them, in great contrast to the Zaghawa and Bideyat tribes, to any of whom an unguarded camel is an irresistible temptation. Several times we happened on stray camels during our journeying, for such are always common in Tibesti, where they turn their camels loose to pasture, to roam at will for weeks on end, confident that should they approach a well someone will give them water. Later they are recovered after much questing and questioning by their casual owners. Nominally Muhammadan, many of the Tibbu have only been converted by the Senussi during the past fifty years, and Islam as yet sits very lightly upon them, and they lack the fanaticism of the south.

Derda Shehai Bogar-Mi, who is of the royal section of the Tuagara, was in the past the nominal ruler of all the Tibesti Tibbu, but his power as a temporal ruler must have been relatively slight. The French have somewhat reduced his rule, making Abd el-Qader Turico-Mi the independent chief of the Tika in the south, and Aleha Gater-Mi of the tribes round Zouar. Shehai, whom I met in Bardaï, is small and very dark. He is old, having ruled through the Turkish, the Senussi, and the French administrations of Bilma and Faya. He is now becoming very deaf and blind, but is as yet clear-headed, and his judgments are much respected. Though he walks with difficulty, he still rides his camel across the mountains. The chieftainship is traditionally shared in turn by three families, but Sala, the Derda's second son, is likely to succeed him.

Bardaï, where Nachtigal had barely escaped with his life, was occupied by the French in 1913. It was evacuated in 1916 owing to the Tuareg revolt in Aïr and the siege of Agadès, and was temporarily entered by Kaossen and a large force of Tuareg. It is the nerve centre of these mountains, and whoever holds Bardaï controls Tibesti. On it converge all the most important roads, and in this valley are grown more than half the dates. The oasis is of great natural beauty, with palms and gardens scattered among weathered pinnacles and turrets of rock, and with wide and distant views of Ehi Ti, Ehi Terké, and Ehi Mousgou.

From here, accompanied by Idris and Dadi, I paid a brief visit to Aozou, which by the abortive Rome Agreement was to have been handed with a large section of northern Tibesti to Italy. The road crossed the high pass of Tirenno and later entered the dark gorge of Nanamsena, where for 4 miles it wound between sheer cliffs 400–700 feet in height and barely 8 yards apart. Aozou possessed a tranquil loveliness in great contrast to the wild beauty of Bardaï. From Bardaï we visited Doon, which is known to the French as the "Trou au Natron," passing many Tibbu with droves of donkeys going down to Bardaï to fetch the ripening dates. The road climbed up the steep side of the Tarso Toussidé, on the summit of which is the crater of Doon. The name





Looking east from Emi Koussi

Crater of Doon, with Toussidé in the background

Near the summit of Emi Koussi

Nanamsena gorge on the Bardaï–Aozou road

Near the Miski valley

Mashakezey gorge in Tibesti

tarso is given to any high steep-sided plateau difficult to ascend yet easy to traverse when once climbed. This *tarso* was sparsely covered with vegetation similar to that found inside the crater of Emi Koussi. The great crater, visible only at a very short distance from its lip, is 18 miles in circumference and 2500 feet deep. Its walls everywhere fall in sheer unbroken precipices. A white carpet of natron covers much of the bottom, in the midst of which are three small cones of volcanic debris. I lacked sufficient time to attempt the descent, which would be far from easy. It is dominated by the two twin cones of Toussidé and Ehi Ti, 10,600 and 9940 feet high and some 10 miles away. Toussidé is the landmark to the caravans arriving from Bilma. We slept in a small ravine to escape the howling wind. Suddenly, soon after sunset, Idris pointed to a wild sheep silhouetted on the cliff above. We had just started our evening meal and this meat, though tough indeed, provided a welcome change. Returning to Bardaï I said good-bye with regret to the lieutenant and two sergeants stationed there and left for the hot springs of Sobouroun, and for Zouar. Khatir, who had been very worn, had benefited from his rest. We reached Sobouroun after passing close under the shoulder of Ehi Mousgou, through fine mountain country. The hot saline springs were in a small valley whose rocks were fantastically streaked with shades of purple, red, orange, green, yellow, and white. Numerous small jets of boiling water were surrounded by basins of boiling mud, while clouds of steam escaped noisily from among the rocks, and the smell of sulphur filled the air. A bath in one of the small hot springs was reputed to cure any ill. Khatir bathed, and developed boils on his leg next day.

We continued through some of the wildest country in Tibesti to the gorge of Forchi. This gorge was 22 miles long, and its walls, 10–30 yards apart, were never less than 200 feet and more often 500–700 feet in height, falling not in tiers, but in one clean, unclimbable face of hard rock. A small clear stream fringed with rushes flowed through much of the gorge, amongst tangled tamarisk and acacia. In the sandy pools scoured at the base of the larger rocks were shoals of small fish, which we tried in vain to catch. In places a few ferns and small bushes, and once some stunted palms, grew out from crevices in the cliff face where water seeped down. Then, passing through groves of dom palms in the wadis Tehagam and Moussoi, we came down to Zouar.

Zouar is the headquarters of the Tibesti *circonscription*. The fort is in a plain surrounded by the rocky foothills of the mountains, and guards the wells, but there are no palms and no permanent village here. I arrived at Zouar on September 27, and heard of the crisis in Europe. I therefore trekked south as fast as possible to Faya, by way of Sherda and Oudigué, the lower Miski, Tigui, and Bédo. Our road lay along the edge of the foothills and was very barren. Here the only vegetation was occasional clumps of *had*, a small woody plant with a few prickly leaves of a dusty bluish-green colour. *Had* is good pasturage for camels. It took us seven days to reach Faya and we averaged thirteen and a half hours' marching a day. Camels, even the best, are never trotted in this country, and much of the marching is done on foot, almost a necessity at night in order to avoid going to sleep. We filled our skins at the deep pool of Oudigué, where the water was as bitter as quinine with the

staling of endless camels. Our next wells were in the oasis of Tigui. In the desert, life's pleasures are very simple but very real: a long drink of clean water; meat to eat after weeks on flour paste; a few hours' sleep when the effort to remain awake has become a torture; or a short linger over a small fire in the cold of the early dawn. There is too the clean, harsh beauty of the desert, ethereal at dawn and sunset; and the freedom, and the comradeship of desert peoples.

Tigui and Bédo are two of the many small oases hidden in the sand-covered rock wastes north of Faya. From Bédo comes much of the salt for which Borkou is famous. The salt works are some 2 miles long by three-quarters of a mile across, and the large sheets of blue water are fringed with palms and green grass. The water is run into small pans and allowed to evaporate, the salt being then moulded into broad cones 9 inches high or into small half-circles 4 inches across. It is of excellent quality and is known as *sugomi*. A caravan of Mahamid Arabs from the south with fifty camels was collecting salt. At Faya, having heard that the crisis was past, I arranged to visit the famous lakes of Ounianga. Dadi left me here, since his animals needed rest. He had been always gay, youthful, and indefatigable, swinging along beside his camel and singing his interminable lilting camel songs. Born in Cufra, he had been brought up by the Senussi, and had only left it last year, so that he talked good Arabic of the Fezzan dialect. The hours passed quickly in his company. In Faya we hired four camels from the Dozza and regretted it. They were clumsy, slow, plodding brutes, soft-footed, so that they limped among the rocks. Of water there was a sufficiency on the road, but no grazing among these volcanic rocks and sand.

We arrived at Ounianga Kebir at dawn. The lakes lie in a deep depression, and our first view of Yoa, the largest of the four lakes, was lovely. The sands were golden in the early light and the dense palm groves along the water's edge threw heavy shadows. The water was a deep sparkling Mediterranean blue, and the cliffs rose-coloured rock. Yoa is 2 miles in length and three-quarters of a mile across. Nearby are the small and strange lakes of Ouma, Midji, and Forodone. The waters of Ouma and Midji are deep red in colour; those of Forodone a vivid green. This colouring is due to minute particles in the water held in suspension. All four lakes are highly impregnated with salt, but warm springs of fresh water flow into Yoa and Ouma in many places along their shores. The salt in Midji forms crusts upthrust throughout the length of the lake. It is collected by the Ounia and is of good quality, though tinted rose. The Fezzan have traditions of great lakes over the whole Ounianga, Gouro, and Tekro area, and there is ample evidence that the present lakes are but a sorry remnant of the past. On the plateau 200 feet above the lake of Yoa and 5 miles from its present shores, I found some fossilized bones of a hippopotamus.

The Ounia who live round these lakes are a small tribe. An interesting if somewhat servile people, they have a language of their own which has affinities with the Bideyat tongue, but it is rapidly dying out and being replaced by Goraan; only the old men now speak it. Surrounded by the Goraan they are abandoning their own peculiar customs and becoming indistinguishable from them. In the past they were entirely sedentary, owning palms and small gar-

dens, and escaping from Fezzan and Tibbu raiders by swimming out into the lakes. To-day they have acquired camels and, neglecting their palms and abandoning their gardens, they make much money by carrying south the salt from Ounianga and Tekro. The former is the last inhabited watering-place on the road to Cufra, through Tekro and Sarra.

After a most interesting two days we engaged four new camels from the Ounia and left for Fada. We passed the dozen small lakes of Ounianga Serir which lie under a long escarpment 30 miles to the east. Only the largest of these lakes is salt, and the others are hidden in thick reed beds. Date palms were numerous, but as neglected as those of Ounianga Kebir. Many Ounia encampments were scattered among the dunes. Anxious to see the far-famed salt works of Dimi we continued eastwards towards Erdi, past the small oasis of Ntegdeï, which before it was worked out produced the best salt in this area. Several caravans of Ounia and Mourdia Goraan were resting here. Approaching Dimi in company with a large Mourdia caravan we entered a belt of moving sand dunes; a long silent line of camels, making their way by moonlight through the soft steep-sided dunes. We arrived at Dimi in the red light of dawn. Low black hills, landmarks from afar, dominate this sterile depression, where a few shadeless acacias alone struggle for life round the wells. The Dimi salt is reddish in colour owing to the sand among the crystals, but much esteemed; it is fetched from Kanem-Batha and Ouadaï. Some 10,000 camels visit Dimi annually.

During the next few days we passed continuous caravans of Mourdia, Gaida, Ounia, Borogat, Birriera, Kobé, and Mahamid Arabs, with each of whom in turn we lingered to exchange our news. Soon after leaving, one of our camels sickened, lying down if even lightly loaded, and though we marched long hours we made poor progress. The wind blew with great violence throughout the day and the driving sand made the midday halt a long discomfort. We passed the tracks of a few addax, but though we kept a sharp look-out we saw none of these antelopes. The Mourdia told us that there were great herds to the north-east in Erdi. Addax inhabit the true sand desert. They rarely if ever drink and find but little moisture in their scanty grazing, yet they are generally fat and their meat a delicacy. There were no white oryx here, though we found a few tracks on the Oued Haouach far to the south. They live on the fringe of the desert, preferring country with a few bushes to the bare dunes, though they move into these if the rich desert grass or *jizzu* has come up after rain. There appear to be relatively few in French Equatorial Africa. The great oryx herds are, or were, on the Wadi Howar in the Anglo-Egyptian Sudan. Dorcas gazelle are not uncommon round the oases and in the wadis in Tibesti. They are abundant and less wary than usual in the Miski. Barbary sheep are numerous in Ennedi and exist throughout the greater part of Tibesti, in greatest numbers probably on Emi Koussi and round the precipitous sides of Doon. Jackals levy a heavy toll from the herds of goats. The Tibbu trap them in elaborate box-traps built of stones. Hyaenas are very rare, though I saw the tracks of two, probably of the striped species, round Bardaï. Leopard exist in Ennedi. We found fresh tracks at Archeï, and the tracks of cheetah in the desert south of Fada. The Bideyat told me that there were lion on the south-eastern edge of these mountains. I

have shot them on the Wadi Howar, where they follow the oryx herds. We passed in the Wadi Nkaola the grave of Ababo, reputed ancestor of the Gaida, a crude stone wall round a tattered mat shelter before which small offerings are made. Many times in Tibesti we had stopped to make these roadside offerings of flour and water, where small heaps of gravel indicated those that had been made before. Then, crossing the north-west edge of Ennedi, where the wadis seemed very green after the harsh mountains of Tibesti and the empty deserts to the north, we entered Fada.

My leave was nearly finished and I had regretfully to abandon my desire to return through the Basso, taking instead the direct road by which I had come up. We travelled for a while with a Kobé caravan from Dimi and then, pushing on, we entered the Warra country. Hamid, Idris's grandfather, had been *melik* (king) of this section until the French had shattered the Kobé forces at Tini and killed their aged Sultan. Hamid had been carried from the field with a shattered thigh by Daud, Idris's father. Idris's uncle was sheikh of the village at which we camped, and here we first saw at sunset the moon of Ramadan. That night we feasted greatly and then, sitting among our camels, heard tell of bygone fights, successful raids, and overwhelming losses until far into the night. Idris, like many young Zaghawa, fretted at security, craving at heart for those wild and lawless days. Possessed of reckless courage, the desert gave satisfaction to this inborn desire for conflict, so that he had sought continuously to rival and outdo the Tibbu in feats of endurance. Though quick-tempered and jealous of his freedom he was a happy, care-free companion and staunchly loyal. At Tini, owing to a misunderstanding, the car which was to have met me had not arrived. El Fasher was still 260 miles away, and but four days of leave remained. We took new camels, and after parting with regret from Khatir, whose herds were on the Wadi Howar, Idris and I rode south through my old district. We reached El Fasher on November 1, after being in the saddle for seventy hours out of the ninety-six.

I had covered a considerable distance during these three months, some 2000 miles in all, but only at the cost of continuous travelling. Many of my observations were in consequence superficial. From the French officers whom I had encountered I had received an almost embarrassing hospitality, a never-failing kindness, and help to go wherever I desired. To them and to the authorities who gave me permission for my journey I owe a great debt of gratitude.

Note: In a few cases the author prefers alternative names to those followed in this paper on the authority of the French official map. He would write Tarso Toh for Tarso Toon, Oued Teghane for Oued Tehagam, Youan for Yoa, Ounianga Saghir for Ounianga Serir, and Niteguedi for Ntegdeï.

NIVATION AND CORRIE EROSION IN WEST SPITSBERGEN

L. H. McCABE

THE main object of the Cambridge Spitsbergen Expedition of 1938 was to examine glacial problems, especially nivation processes and corrie development, in continuation of the work carried out in Iceland by W. V. Lewis [1] in 1937 on the Cambridge East Iceland Expedition, of which I was a member. The present expedition consisted of M. B. Adams, R.E., surveyor; W. G. V. Balchin, geomorphologist; W. B. Harland, geologist; L. H. McCabe, leader and geomorphologist; P. M. M. Pritchard, medical officer and quartermaster; N. Pye, surveyor.

Our main base was at Bruce City on the north-east corner of Billefjord (Klaas Billen Bay), and the Scottish Spitsbergen Syndicate allowed us to use their huts in this locality. These huts are situated on an old shingle beach, now elevated some 20 feet above sea-level. Inland, the coastal plain rises to the foot of the Campbell range, which forms an abrupt escarpment attaining a height of 2600 feet. These mountains are composed of Carboniferous limestones and gypsiferous series dipping very slightly to the south, and are the remains of an old plateau subjected to block faulting and sculptured by corrie erosion. Behind these mountains is an interlocking system of valleys, of rectangular pattern, and east of these lies Gips valley running in a N.E.–S.W. direction parallel to Billefjord. Wide glacier-free valleys occur; and with the area relatively free from summer snow, glacierization mainly takes the form of small corrie glaciers, snow gullies, and snowdrift accumulations on the flat summits of the mountains.

Four weeks were spent at Bruce City and then a party of three travelled to the east coast of Wijde Bay and spent ten days in the Stubendorff mountains. These mountains, which consist of crystalline gneiss and schists, show a very much heavier glacierization than the Billefjord region, and are the remains of an uplifted peneplane of mid-Palaeozoic age dissected by large valleys and deep corries. The dissected plateau is most evident in the coastal mountains. Inland, glacial erosion has been heavier and shapely pyramidal peaks are the only remnants of the former plateau. At the same time another party visited Gips Bay, surveyed the raised features, and returned up the west coast of Billefjord. They had with them a small rowing boat and a 4-h.p. Britannia Light Twin outboard motor, which proved excellent.

Both parties reunited at Bruce City and were picked up by the s.s. *Lyngen* on September 6. I would like to take this opportunity of thanking Wolmer Marlow, Governor of Spitsbergen, for his hospitality to the two members of the expedition whom he entertained at Longyear City and for his many kindnesses to the expedition as a whole.

The expedition was only made possible through the generous financial assistance of the Royal Geographical Society, the Gino Watkins Memorial Fund Committee, the Worts Fund, the Wigan Education Committee, and several colleges at Cambridge. In organizing it much help was received from

[1] W. V. Lewis, "Snow-patch erosion in Iceland," *Geogr. J.* 94 (1939) 153.

a large number of friends, and I am particularly indebted to Mr. N. A. C. Croft, Professor F. Debenham, the Reverend W. L. S. Fleming, Mr. A. R. Hinks, Mr. W. V. Lewis, Mr. J. A. Steers, Mr. J. M. Wordie, and to Mr. B. B. Roberts, who acted as our home agent. We are also grateful to Dr. G. W. Tyrrell and Mr. J. Mathieson for the geological and topographical information which they placed at the disposal of the expedition. Valuable assistance and advice were obtained from Dr. Hoel's office in Oslo, through whose agency the Norwegian Government authorities kindly granted us special custom facilities. Mr. Carl Saether, the British Vice-Consul in Tromsø, gave us every assistance that lay in his power. The cooperation of the officials of the B. & N. Line and the Troms Fylkes Dampskibsselskap greatly facilitated the journey. Finally, many firms presented us with goods free or at reduced prices, and we are particularly indebted to them for their generosity.

The survey work

The survey had two main objects: to ascertain the exact position of the head of Gips valley; and to produce a large-scale map of the Campbell range which would serve as the basis for the geological mapping and for the distributional and morphological aspects of our work on snow and ice erosion.[1]

The work on Gips valley was done by M. B. Adams, who carried a network of triangles from Bruce City to Mount Robert, the summit of which overlooks a glacier occupying a branch of Gips valley. An estimation of mean sea-level was made by observation on a post driven into the beach a little below low water. From this post levelling was carried up to both ends of the base, which had a length of 6037 feet over a fairly level stretch of raised shingle beach. The theodolite observations at the several stations were spread over a considerable period of time owing to adverse weather conditions. For this work we used a Watts $3^1/_4$-inch micrometer theodolite, which proved quite satisfactory. A plane-table map of the head of Gips valley on a scale of 2 inches to 1 mile was made by N. Pye. Fine weather made it possible to survey an area of 50 square miles in a week.

Pye also mapped the Campbell range on a scale of 4 inches to 1 mile. Experience showed that this scale is too large for topographical mapping, unless there is a spare man for beaconing. The theodolite triangulation will enable this map to be joined to the map of Gips valley.

As detailed a survey as time would allow of the area visited in the Stubendorff mountains was made by M. B. Adams. The map was plotted from prismatic compass and abney level readings, and the detail filled in from our photographs. An oil compass proved to be too sluggish at temperatures near or below freezing-point, and the ordinary military pattern was used.

During the whole time that the expedition was in the field there were 21 good surveying days, 21 days when surveying was possible up to 800 feet, and 18 days on which surveying was impossible. The plane-table is undoubtedly the most efficient instrument for topographical survey of small

[1] The east coast of Billefjord and the lower part of Gips valley had already been mapped by Mr. J. Mathieson in 1919 and 1920, and the Campbell range had been surveyed by the Svalbard Commissioner of the Scottish Spitsbergen Syndicate, Ltd.; scale 1 : 50,000. Unfortunately, neither of these maps quite fulfilled our requirements.

areas in Spitsbergen; but for large areas the aerial survey, which is being carried out by the Norwegian Government, is probably the most economical of time and expense.

Nivation processes

At the end of the last century, F. E. Matthes [1] published an important paper in which he gave evidence to show that snow-patches deepen and accentuate the hollows in which they lie. He considered that this was accomplished by the alternate freeze and thaw of the melt-water at the receding margins of a snow-patch in summer. This excessive frost action comminuted the surface material, which was carried away by the abundant water set free from the melting snow; as the snow-patch decreased in size this action would be extended over the whole depression. This process he termed nivation. Some years later Bowman [2] arrived at similar conclusions from his work in the Andes, except that he believed that a snow mass on a steep slope moved and plucked the surface on which it lay. Matthes's theory was generally accepted as correct and Taylor,[3] in the Antarctic, applied it to explain the development of corries from initial nivation hollows. Priestley [4] however accepted it with reservations, at least as far as the Antarctic was concerned, both on account of the meagre amount of thawing, which took place only in summer, and the thinness of many of the large snow-patches which he encountered. Rather than deepening their beds he suggested that snow-patches widened them.

New light was thrown on this problem by the work of W. V. Lewis in Iceland on the Cambridge Expedition to Vatnajökull [5] in 1932 and on the Cambridge East Iceland Expedition [6] in 1937. It was found that on warm days melt-water, either from the upper margins of the snow-patch or from higher up the hillside, melted its way underneath the snow, and at night, or during a colder spell, this water ceased to flow and the thawed portion of the ground underneath the snow-patch froze. Frost action was thus possible underneath the centre of the snow-patch as well as at the sides. The material thus comminuted was carried away by the trickling water. Providing these processes took place more rapidly than on the surrounding snow-free hillside the snow-patch tended to deepen its bed. This action was made possible in Iceland by the liberation of a vast supply of water from the melting snows and the profuse quantity of moisture due to the heavy precipitation. The observations recorded below were carried out in Spitsbergen in the light of the work of the Cambridge East Iceland Expedition. The problem of nivation was examined in a region of different geological structure and with a lower summer day temperature than is experienced in Iceland.

[1] F. E. Matthes, "Glacial sculpture of the Bighorn Mountains, Wyoming," *A.R. Geol. Surv. U.S.*, 1899–1900, Pt. II, p. 180.

[2] I. Bowman, 'The Andes of southern Peru.' London, 1920, p. 286.

[3] G. Taylor, "Physiography of McMurdo Sound." British Antarctic Expedition Report. London, 1922, p. 164.

[4] R. E. Priestley, "Physiography of Robertson Bay and Terra Nova Bay regions." British Antarctic Expedition Report. London, 1922, p. 37.

[5] W. V. Lewis, "Nivation, river grading, and shoreline development in South-East Iceland," *Geogr. J.* 88 (1936) 433.

[6] W. V. Lewis, "Snow-patch erosion in Iceland," *Geogr. J.* 94 (1939) 153.

We found that melting proceeded almost continuously throughout the summer. It was evident that in winter the whole surface would be covered by snow, even down to sea-level. Most of this had disappeared by the beginning of July, but many isolated patches remained, though these were much reduced in size and number by the end of August.

The snow-patches can be divided into two main classes: (1) those which occur in regions of soft rocks or solifluction slopes, and are frequently circular, and occupy shallow round-bottomed depressions; (2) those which occur on

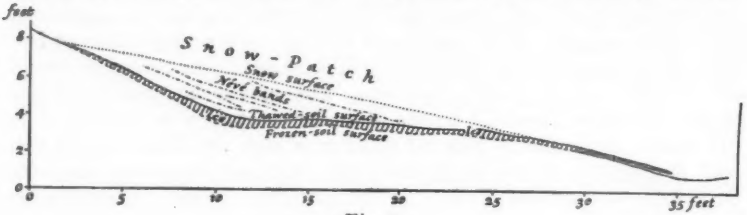


Fig. 1

the scree slopes of the mountains, and are long rather than circular, with an upper limit often marked by a small vertical cliff of harder limestone.

(1) The first snow-patch examined occurred near sea-level. A section was cut through it on July 10 and is reproduced in Fig. 1. When the section was dug the air temperature was 48° F. and melting was taking place at the upper and lower margins of the snow-patch. Above it the ground was soggy and had thawed, but under the edge of the snow the soil was frozen to the base of the snow mass. The bottom layers of the patch were found to consist of grey ice which underlay the whole snow-patch. Somewhat different con-

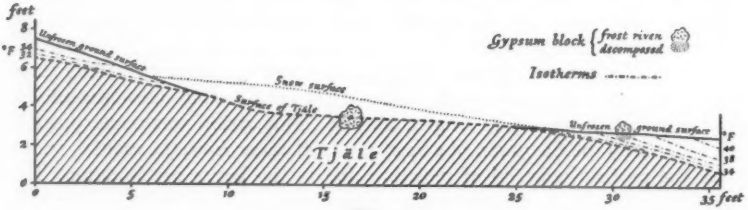


Fig. 2

ditions were found within 2 or 3 feet of the lower margin of the snow-patch. Melting had changed the snow into ice, the underside of which was no longer frozen to the ground; it could be removed without disturbing the soil beneath it. The surface of the ground was thawed for a thickness of one-eighth of an inch and was very wet. Within a foot of the edge there was a space between the ice and the soil beneath. Thin trickles of water oozed from the lower end of the snow-patch throughout its whole width, but these streams were not observed to be moving any material.

A circular snow-patch was examined, and Fig. 2 was constructed from the observations which were made. It illustrates the relation of the frozen sub-

soil or *tjäle* and the vertical distribution of soil temperatures to the surface of the ground in the neighbourhood of a small snow-patch. Near the edge of the snow the *tjäle* approaches the surface and underneath the snow the soil is completely frozen. The possible significance of this will be discussed later. The conditions beneath the snow resembled in many ways those beneath the previous snow-patch, but there were certain differences: a foot inwards from the upper edge of the snow the ground was thawed for a thickness of about one-twentieth of an inch. A week later the thawed surface was found to extend a yard in from the edge of the patch, but beyond this the ground became frozen to the base of the ice, which was found to underlie the snow as in the previous case. At the lower end of the snow-patch conditions similar to those observed in the first example were also found. Below the patch the ground consisted of a deposit of fine mud. An outcrop of gypsiferous series gave rise to many large blocks within and round the snow-patch. Many of these rested in the mud below the patch, and their embedded portions were decomposed into a soft wet mass. Some blocks were found beneath the snow-patch. They were undecomposed where they were embedded in the frozen subsoil. But decomposition was beginning to take effect at the level of the soil surface and was probably due to the occasional thawing of the surface underneath the snow-patch.

The snow disappeared by the end of August, and the whole bed was exposed, consisting of a fairly steep slope of angular stones and coarse mud. On the floor of the depression, mud and stones were intermingled haphazardly, except for occasional lines of fine brown mud.[1] These probably marked the course of small rivulets, which had trickled down under the snow-patch and had become choked as the snow dwindled. A few large stones were also found, and some of these appeared to be arranged in lines down the steepest slope. The ground contained far less moisture than it had done when the snow-patch was present.

Plate 3 shows a small snow-patch at the head of a gully on the north-west face of the Campbell range. A stream emerged from its base and must have had considerable corrasive power. Yet where the snow-patch occurred, the steep V-shaped sides of the valley were widened and cut back to form a U, while at the upper margin of the snow-patch the surface was cliffed as though the snow and ice were undercutting it. These cliffs were not due to a harder outcrop as is sometimes the case, but were cut in solifluction terraces and scree slopes. In this case we have an example of a snow-patch resting on a steep slope, not only deepening and extending its bed but keeping pace with a fast-flowing stream below it, and we seem to have a rounding of the contours as suggested by Lewis in the case of Iceland.[2] The bed of this stream, in common with that of other similar streams, was marked by large angular boulders of varying sizes, and no doubt the stream performs a certain amount of corrasion. But the volume of water, even on warm days, was fairly small, and generally the streams did not seem able to move any of the larger boulders in their courses. Rather they gave the impression of removing the finer material from the debris comminuted and set loose by nivation, as has

[1] See p. 454.

[2] W. V. Lewis, *Geogr. J.* 88 (1936) 434.

already been suggested by Cole.[1] They appeared to carry a slight amount of very fine material in suspension. Beneath the snow-patch, processes similar to those observed in previous examples were at work. This snow-patch is probably permanent, as the above observations were made at the beginning of September.

(2) Quite different in their appearance and to a certain extent in their mode of alimentation, since it is partly due to snow avalanches from higher up the hillside, are the longitudinal snow-patches which streak the sides of the mountains of this region and give them a distinctive appearance. Their upper margin is usually marked by a cliff of more resistant limestone varying from 2 to 30 feet in height. Frequently a second snow-patch occurs above this cliff, and occasionally the two may be joined by a narrow neck of snow which traverses a gully cut through the outcrop.

A large patch of this type was examined on July 27. It was about 400 yards in length and its surface slope was about 30°, steepening towards the top, where it was backed by a cliff about 20 feet high. This cliff extended a considerable distance on either side beyond the limits of the snow-patch itself, but small isolated lumps of snow indicated that the snow covering of this area had not long disappeared. Several small streams were pouring down the backwall, but they had failed to notch the rock except in one case in which it was associated with a well-marked joint. The wall itself was shattered and rotten, especially towards its base, and it had a definite overhang, which was greatest above the snow-patch. Marginal melting had removed the snow immediately below the wall, and a cleft about 2 feet deep and varying in width between 2 and 6 feet separated the upper margin of the snow-patch from the rockwall. The floor of the cleft consisted of unfrozen, loose, angular boulder, most of which must have fallen from the headwall and not from the scree above, as any falls from this latter source would reach the ground some distance out, on account of the overhang. A small patch of snow had been left in the cleft and lay in the angle between the backwall and the floor. A thin film of water was trickling down the backwall and froze as it passed underneath this mass of snow. The main snow-patch was 4 feet thick at its upper edge. A thin film of ice underlay the snow and it conformed to the contours of the ground rather than to those of the snow surface.

Before summing up the main points bearing on the subject of nivation, it is worth quoting some observations made during a night spent studying one of these patches.

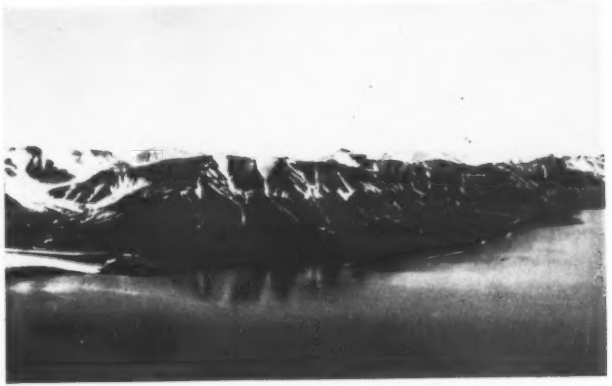
The patch in question was at an altitude of 1500 feet on the west-facing side of the spur which divides the MacLeod corrie into two, and only measured about 20 yards by 15 yards. It rested on a fairly steep slope (about 15°) of solifluxing material, mainly of stones varying in size from a quarter of an inch to 3 inches in diameter. The observations were conducted on the night of August 31 when, fortunately, a warm sunny day was followed by a cold clear night, which gave a minimum air temperature of 27° F., so that ample opportunity was afforded for watching the process of freeze and thaw. Observations

[1] G. A. J. Cole, "Glacial features of Spitsbergen in relation to Irish geology," *Proc. R. Irish Acad.* 29B (1911) 193.

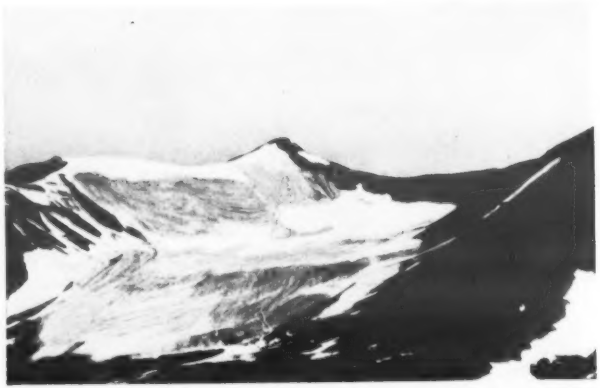
1. The head of Gips valley, with Margaret glacier in the middle distance

2. MacLeod corrie, with two small glaciers on a floor of resistant strata overlying the gypsiferous series

3. Small snow-patch, Campbell range



4. Campbell range from Wordie Crags



5. East corrie: the step in the floor above the resistant strata

6. The Carron divide

5. *East corrie: the step in the floor above the resistant strata*

6. *The Carron divide*

were begun at 2000^h just after the sun had disappeared behind the Pyramid Mountain in Dickson Land, resulting in a very sudden decrease in temperature.

At 2100^h all the usual features were present. At the upper edge of the snow-patch the ground was frozen; at the lower end melting was rapid and a space of a quarter of an inch existed between the surface of the ground and the base of the patch. A hole was dug 3 feet inside the lower edge, and revealed that the ground appeared to be frozen, although it is possible that a very thin surface layer had thawed, since water partially filled the hole and it certainly did not flow from the surface of the snow-patch. The heavy flow of water from the lower end of the patch gave rise to little rivulets, which saturated the ground below it. At 0000^h the ground below the snow-patch was frozen and the water, which still dripped on to it from the snow, appeared to freeze almost immediately upon touching the soil.[1] This frozen crust was separated from the *tjäle* by a layer of unfrozen material. Similar conditions were found

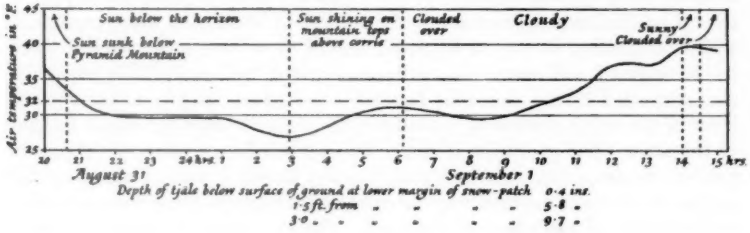

Air temperature in °F.
45
40
35
32
30
25
Sun below the horizon
Sun sunk below Pyramid Mountain
Sun shining on mountain tops above corrie
Clouded over
Cloudy
Sunny
Clouded over
20 21 22 23 24 hrs. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 hrs.
August 31
September 1
Depth of tjale below surface of ground at lower margin of snow-patch 0·4 ins.
1·5 ft. from " " " " 5·8 "
3·0 " " " " " 9·7 "

Fig. 3

at the sides of the snow-patch, but at its upper margin the ground was frozen solid. The minimum temperature was recorded at 0300^h. All melting had then ceased, although it had continued till past 0200^h, and the surface in the vicinity of the snow-patch was frozen hard to a depth of three-quarters of an inch. Beneath this the soil was unfrozen and saturated down to the level of the *tjäle*. At a distance of more than 12 feet from the snow-patch only a very thin surface crust was frozen. A thin sheet of clear ice adhered to the underside of the dirty ice which underlay the snow; and beneath this a thin layer of ice had spread over the ground. The ice was obviously due to the freezing of the melt-water of the previous day. After 0300^h the air temperature began to rise, but it was not until nearly 1100^h that it rose above freezing-point. The reading was then 33°, but the ground was still frozen round the snow-patch although thawing had begun at some distance from it. By 1200^h the air temperature had risen to 37° F., but melting of the snow had not yet begun, whereas thawing of the soil surface had been in progress for some time, being most complete where freezing had been least severe. It was not until 1400^h, when the temperature had risen to 39° F., that melting began. Some distance away from the patch the surface had completely thawed, but near it only a thin crust had yet done so. At 1500^h melting was definitely established, and although the frozen crust had not entirely thawed, it was obvious that this would soon be effected.

[1] The anomalous nature of the midnight temperature makes it clear that I misread it.

Summing up the results of our observations we may note the following facts:

Many small snow-patches occur in hollows with steepened sides, or small cliffs, which show signs of recent erosion. Stream action can have played no part in the formation of these features beyond aiding the removal of material. The ground beneath a snow-patch is frozen to the base of it. On warm days melting occurs at the edges of the snow and saturates the ground round the patch.

A layer of ice underlies the snow. In none of the snow-patches examined can it have been the result of pressure. Nor can it have been the remains of a former year's snow-patch, since it was present beneath every example observed, many of which disappeared early in the summer. Moreover the surface of the ice was concave, whereas the surface of the snow was usually convex. The most probable explanation of this ice is that water, provided by the melting round the edge of the snow-patch or from a source higher up the hillside, melts its way underneath the patch and freezes when the supply is cut off or diminished. The larger the volume of water, the more capable it will be of melting its way to the lower end of the snow-patch; the less there is, the sooner it will freeze on passing underneath the snow. This process is also suggested by the fact that beneath some snow-patches a thin surface layer of the soil is thawed at a considerable distance from the upper margin of the snow. The profusion of water beneath the lower parts of the snow-patches confirms this view and points to the fact that water formed on the surface of the snow melts its way downwards through the snow mass and adds to the volume of water beneath the patch. Visits to tunnels formed by streams through large snow-patches in Spitsbergen and Iceland showed that water was dripping from the roof of the cave, thus illustrating the suggestion just made.

On cold nights the water beneath a snow-patch freezes, and this action is more intense than on the snow-free areas, owing to the greater amount of moisture present. The nearness of the *tjäle* to the base of the snow must be very important, since it confines the melt-water to a very thin layer of soil, which thus suffers more intense frost action than the snow-free areas.

Thus it appears that alternate freeze and thaw take place more vigorously beneath a snow-patch than on the exposed surfaces; certainly the material in many of the hollows tends to be finer than on the snow-free areas. But nivation cannot proceed without the removal of the comminuted material. The rivulets and sheets of water from small snow-patches were clear and were not seen to move any material. Nevertheless deposits of fine mud existed below many snow-patches, even where the patch lay on coarse scree. If this mud were disturbed, the streams became turbid and carried some of it away. It is probable that the streams move the fine material very slowly when it is not disturbed artificially. These observations, together with the streams of mud, point strongly towards the removal of material from beneath the small snow-patches. However, an attempt to obtain a sample of the material, if any, moved by these streams yielded one small grain of fine sand in a period of three hours. Where the *tjäle* is 1 foot or more from the surface, much of the melt-water will sink downwards through the ground. But where it is very near the surface, the water will flow over it, and will thus be able to move material.

A large stream under a snow-patch obviously aids the removal of material. All such streams contained very fine matter in suspension and their channels were filled with many large angular stones. Moreover, if a large stream flows beneath a snow-patch, it melts a tunnel through the deepest part of it and allows warm air to penetrate to the base of the snow mass. Indeed, it acts as a thawing agent itself as it swirls down its channel, splashing and moistening the rocks on either side. The effect of this action was clearly seen in a small cave which was found at the base of one of the large snow gullies, on the north-west face of the Campbell range. A small but rapid stream was flowing down its centre. Fig. 4 shows ledges marking the former bed of the stream, indicating that earlier in the year the stream flowed in a channel cut in the hard snow and not over the rock bed of the gully. Subsequently it must have melted its way down to the rock beneath the snow. Thus the stream had been

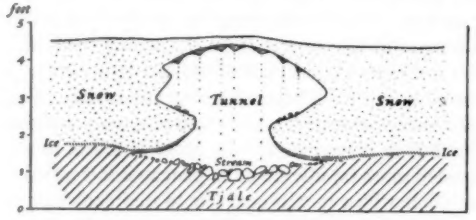


Fig. 4

in contact with the rock only for a short period that year, and this fact reduces the possibility of vigorous stream erosion in these gullies.

The observations which have been cited point strongly to the fact that nivation is active in Spitsbergen. On the other hand Balchin observed that snow-patches resting at the foot of the raised beaches were protecting the ground beneath them. Freeze and thaw seemed to have no effect on the beach shingle. This suggests that the action of nivation is, to a certain extent, dependent on the terrain which harbours the snow. It is ineffective on beach shingle and probably on solid rock unless it is well jointed, as are the limestones of the Campbell range, or cleaved, as are the schists of the Stubendorff mountains. It appears to be most active on solifluction slopes, but varies with the nature of the rock. It is far more effective on the tuffs and basalts of Iceland than on the limestone or metamorphic rocks of Spitsbergen.

Climatic differences may also help to explain the greater physiographical importance of snow-patch erosion in Iceland, where nivation hollows are often very large.[1] Two climatic factors must influence the rate of nivation: the frequency with which the air temperature crosses the freezing-point, and the amount of melt-water.

In Spitsbergen there is little daily variation in air temperature in summer. We experienced a very small daily range at sea-level, and the records for Green Harbour show that the means of both the daily maxima and minima for the months of July and August are above freezing-point. In winter the tempera-

[1] W. V. Lewis, *Geogr. J.* 94 (1939) 153.

ture hardly ever rises above freezing-point for several months. Thus severe frost action is limited to the spring and autumn. In Iceland the mean daily maxima and minima are on opposite sides of the freezing-point for a greater number of months. Thus severe frost action in Iceland is probably active over a longer period of time than in Spitsbergen. Although the summer day temperature in Spitsbergen is consistently above freezing-point it is not high enough to cause the profuse melting which occurs in Iceland, where a very heavy precipitation also adds to the surface moisture. This adequate supply of water ensures that the comminuted material is carried away more rapidly and effectively than in Spitsbergen.

Slope must have an important influence on the rate of nivation. Cole [1] has remarked that snow will not remain for long on very steep slopes. We never found a snow-patch resting on a slope of much more than 40°. Thus nivation cannot proceed on slopes greater than this, nor can it have much effect on a flat surface. The snow-patches on the level parts of the summit of the Campbell range did not appear to be deepening their beds. Garwood [2] claims that this indicates glacial protection, but it is hardly a test case for this much-debated question. Thus in his view the surface of the flat summits in Spitsbergen is being protected, while the flanks are retreating under active erosion agents. But it is normal for the sides of block mountains in arid [3] regions to be eroded more rapidly than the plateau is lowered, and the example under discussion is hardly a special case due to the blanketing action of snow.

As soon as the surface is given a slope, nivation begins and appears to become more active as the slope is increased to 30°. I doubt whether there is much further growth in its power on slopes greater than 30°, and as a slope of 40° is approached its importance rapidly declines.

In conclusion we may claim that many snow-patches in Spitsbergen were found to be deepening the hollows in which they lay, not by movement and erosion, but by the alternate freezing and thawing of the melt-water at their margins and beneath them, and by the removal of the comminuted debris by water trickling underneath the snow-patch.[4] This action is made possible by the greater supply of water in the vicinity of a snow-patch than at some distance from it. This profusion of water is due to the melting of the snow, to the nearness of the *tjäle* to the surface of the ground beneath a snow-patch and the consequent restriction of all melt-water to a very thin layer of soil. On the snow-free areas the surface water, if any, is diffused through a considerable depth of material and its power to break up the scree is small, nor does it flow over the surface of the ground and move material. But the water beneath a snow-patch is restricted to a very thin surface layer which suffers rapidly from freeze and thaw effects, and there is sufficient water to remove the comminuted material.

Finally, rock structure, slope, and climate each influence nivation, and the

[1] G. A. J. Cole, *loc. cit.*, p. 196.

[2] E. J. Garwood, "Features of Alpine scenery due to glacial protection," *Geogr. J.* 36 (1910) 311.

[3] G. W. Tyrrell, "Spitsbergen," *Proc. R. Phil. Soc. Glasg.* 58 (1929–30) 66.

[4] W. V. Lewis, "Snow-patch erosion in Iceland," *loc. cit.*

differences between the nivation hollows of Spitsbergen and Iceland are probably due to the climatic and geological dissimilarities between these two countries.

Corrie erosion

Stratigraphy and structure of the Campbell range and their influence on corrie erosion.[1] The Campbell range is part of a larger region of unfolded rocks with a general dip of just over 2° to the south. Where exposures of solid rock are found on the coastal lowlands there is clear evidence of considerable downthrow and it is reasonable to conclude that the coastal escarpment and some of the larger transverse valleys are partly determined by block faulting. The range is entirely composed of Carboniferous rocks, and as a result of the southerly dip the underlying pre-Devonian metamorphic complex is exposed increasingly to the north and the Permo-Carboniferous rocks are seen in the summit of Mount Tyrrell immediately to the south.

The succession may be tabulated thus:

Limestone series	*Spirifer* limestone	Permo-Carboniferous
	Cyathophyllum limestone	
Gypsiferous series		Carboniferous (Campbell range)
Coal measures (unconformity)		
Metamorphic complex		Pre-Devonian

The coal measures are exposed at the base of the mountains and have no influence on corrie erosion. The gypsiferous series consists of more than 400 feet of alternating bands of dolomitic and bituminous limestones in thicker gypsum and anhydrite. They form the lower bluffs of the range and are capped by more resistant rocks, mainly deltaic sandstones and shales with cementstones and cherty limestones. These rocks are poorly exposed and the overlying series, consisting of very soft slumped boulder beds with limestone breccias showing considerable evidence of contemporary disturbances, is almost invariably covered with scree.

In contrast to this scree-covered slope is the next and most conspicuous horizon of black irregular crags. These are formed by calcite mudstones, brecciated and faulted at the base, and alternating with yellow bedded argillaceous limestones higher up. The remainder of the mountain escarpment consists of a series of large and small scarps mostly exposing a variety of fossiliferous limestone. The removal of a further development of soft brecciated limestone from the top of the range accounts for some of their conformity in height.

The erosion of the corries which break up the range has largely been determined and guided by the geological structure.

Vertical control by joints and faults is not nearly so conspicuous as in the Stubendorff mountains, but E.–W. jointing (and to a less extent N.E.–S.W. jointing) and the small-scale contemporaneous faulting in the limestones are

[1] I am much indebted to Mr. W. B. Harland, who has written most of this geological section for me; also to the many other friends who, by their advice and criticism, have helped with the paper.

important factors in erosion. A glance at the map will show that the E.–W. jointing is reflected in the orientation of the large corries.

Horizontal or stratigraphical control of erosion is much more marked. The characteristic form of the longitudinal snow-patches is V-shaped, terminating at a scarp above and tapering downwards to a neck through the scarp formed by the black crags. The general pattern of the snow-patches tends to conform to that of the scree fans, giving a characteristic "hour-glass" form, and the main constrictions are at the horizons of the black crags and the upper part of the gypsiferous series.

Between these two horizons the development of the corries has taken place. The tough sandstones and limestones above the gypsiferous series form a platform in both the bluffs and the floor of so many corries. Corrie erosion has extended along this horizon, removing the soft breccias and limestones in the North, East, MacLeod, and Wotherspoon corries. The upper limits of these corrie glaciers, as defined by the bergschrunds, are also situated at a very constant horizon at the base of the black crags.

At the top of the mountain escarpment a massive coral limestone has determined the level of many cols and supports the ice carapace on the south of the range and the ice divide to the south of the East corrie.

The structure and stratigraphy of the range are reflected in the erosion and topographic form. In a vertical plane the jointing and a small-scale faulting have influenced the general form, if not the location, of the snow gullies and corries. In a horizontal plane the alternation of hard and soft bands is reflected noticeably in the shape of the longitudinal snow-patches and markedly in the elevation of the floors and headwalls of the corries.

Orientation of the corries. Corrie erosion has attacked all sides of the range except the southern slopes. But all the corrie glaciers lie on north-facing slopes, and this contrast is seen to advantage in the MacLeod corrie. The north side harbours two small glaciers, mere remnants of a once larger glacier which in times past must have filled the whole corrie floor. The south side consists of scree slopes and several snow gullies. As the glaciers retreated shade seems to have become of increasing importance in influencing their position and orientation.

Unfortunately there are no meteorological records for Bruce City other than those kept by this and previous summer expeditions.[1] But meteorological observations have been kept at Green Harbour on the south side of Ice Fjord, some 60 miles south-west of Bruce City, for a number of years. These show that the predominant direction of the wind is from the south and south-east, although the north-east wind predominates in summer. Southerly winds are most common in winter, when precipitation is also heaviest. Thus the main moisture-bearing winds are from the south and south-east, and we may presume that these conditions also prevail at Bruce City, except that the N.E.–S.W. valleys probably deflect the winds somewhat and impart a westerly component to the winds from the south.[2] Much

[1] J. S. Benson, "Meteorology." Oxford University Expedition to Spitsbergen, 1933. Appendix III. *Geogr. J.* 84 (1934) 122.

[2] Our own observation at Bruce City showed a predominance of south-westerly rather than southerly and south-easterly winds.

of the snow which falls on the west slopes is therefore probably carried over on to the lee sides. Moreover the surface of the snow-patches which collect on the summit will tend to be blown towards the lee cliff, and this action is evinced in the numerous cornices which are almost entirely limited to the north-east, north, and north-west flanks of the mountains. These cornices help to feed the gullies which, in many cases, lead down to a glacier below. Thus the heaviest glaciation occurs on the shaded sides of the mountains and in the lee of the prevailing winds.

Origin of corries in the Campbell range. The Campbell range exhibits features linking the original snow gullies with a fully matured corrie.

Plate 4 shows that several incipient corries exist on the seaward face of these mountains. The second from the left, known as Everest Ascent, was a good example of a well-developed single snow gully. It was divided into three parts: an upper wide and steep V, a central stretch where the slope was less but where the snow widens out again, and a lower portion where it filled the bottom of a deep gully, between two spurs formed by the gypsiferous series. The middle section seems to be the most important as far as corrie development is concerned, since the corrie glaciers occupy depressions which have been eroded between the black crags and the gypsiferous series.

A further development is well illustrated in the gully system north of Everest Ascent, where three V's have united below the black crags and have given rise to a large amphitheatre in which the rounded forms of the corrie can be seen. A platform on a bluff of the gypsiferous series occurs at the lower end of the amphitheatre. It is upon this platform that a glacier might be expected to develop. At present the only extensive and permanent masses of ice in this incipient corrie are the tongues of ice above the black crags. Numerous cracks in the surface ice of these tongues and the milky nature of the streams suggested that glacial movement might take place. An attempt was made to ascertain if there was any movement by means of theodolite observations on to a post; but over a period of seven days, movement, if any, was so small that it was well within the observational error and could not be measured by this means.

The next stage, where a small glacier has begun to form on the platform above the gypsiferous series, is absent. The following stage is seen in the North corrie, where numerous gullies feed a large glacier whose bed lies on the platform above the gypsiferous series and whose backwall is formed by the black crag limestone. Separated from this corrie by a narrow ridge is the MacLeod corrie. This and the East corrie seem to be lowering the col between them, presenting an example of a maturely grooved upland.[1] At the head of the Carron glacier (Plate 6) there is a col between Mount Robert and the Campbell range. This is covered by ice at a similar elevation to that of the surface of the corrie glaciers. At the crest of the rise a large and wide crevasse separates the northward from the southward flowing ice. There seems to be no doubt that here is an example of the final stage of corrie development. The ridge formerly connecting the Campbell range with Mount Robert has been obliterated by the sapping and plucking action of glaciers nestling at its base.

[1] W. H. Hobbs, "The cycle of mountain glaciation," *Geogr. J.* 35 (1910) 155.

Corrie erosion. The map shows more convincingly than any description the amount by which the Campbell range has been dissected by corrie erosion. No less than four large glacier-filled corries exist, and the mode of their formation occupied considerable attention.

Helland [1] and Lorange [2] were among the first to recognize the importance of corrie erosion, but in spite of their work many of the earlier physiographers [3] confined their researches mainly to the floors of the large glacial valleys. In 1904 W. D. Johnson [4] published an important paper emphasizing the rôle of the bergschrund in corrie formation. His bergschrund hypothesis was accepted by many of his contemporaries, and it was only with the passing of time that its limitations were realized. Bowman [5] questioned it in the Andes, and in the Antarctic Priestley [6] found that corries existed without bergschrunds. Recently the work of N. E. Odell [7] in Spitsbergen and Greenland and Lewis [8] in England and Iceland has put the problem on a new basis. Johnson's hypothesis is inadequate to explain the features observed, in that the bergschrund is frequently absent or blocked by snow bridges; nor does his theory explain the nature of the erosion of that part of the backwall which is covered by the motionless névé. Both Lewis and Odell have pointed out that melt-water pours down the rockwall of the corrie; this moistens the surface over which it flows and melts its way between the glacier and the backwall. In colder periods the supply of moisture ceases and the thawed surface will freeze, so that the process of frost shattering is extended over the whole of the backwall and not merely over the exposed portions of it at the foot of the bergschrund.

The crux of the problem seems to lie in the nature of the bergschrund, and in the presence or absence of melt-water pouring down the backwall and the possibility of its freezing. Fortunately opportunity was afforded of examining these features in corries of very different topographic form and eroded into rocks of very different structure and material.

The corries of the Campbell range vary in size from the shallow but wide North corrie to the deep and dual-headed MacLeod corrie. The former is filled by a glacier which occupies the whole of its floor. The bergschrund series occurs 100 feet below the black crag outcrop. When first visited on July 7 it was entirely covered by snow and the only evidence that it existed was seen in a few small cracks in the surface of the glacier. A visit on September 3 revealed that considerable melting had taken place, but the bergschrund in the centre of the glacier was still covered by a large snow-bridge. This had sunk 2 or 3 feet below the surface of the upper side of

[1] A. Helland, "On the ice-fjords of N. Greenland and on the formation of fjords, lakes, and cirques in Norway and Greenland," *Quart. J. geol. Soc. Lond.* 33 (1877) 61.

[2] Lieutenant Lorange. See paper by Helland above.

[3] A. Penck, "Glacial features of the Alps," *J. Geol.* 13 (1905) 1.

[4] W. D. Johnson, "Profile of maturity in Alpine glacial erosion," *J. Geol.* 12 (1904) 573.

[5] I. Bowman, *op. cit.*, p. 297.

[6] R. E. Priestley, *op. cit.*, p. 42.

[7] N. E. Odell, "The glaciers and morphology of the Franz Joseph Fjord region of N.E. Greenland," *Geogr. J.* 95 (1933) 246.

[8] W. V. Lewis, "A melt-water hypothesis of cirque formation," *Geol. Mag. Lond.* 75 (1938) 249.

the crevasse. Thus 2 or 3 feet of that side of the schrund were visible, and a small stream emerged from a hole 2 feet below the glacier surface and poured down into the crevasse. Towards the eastern side of the corrie the bergschrund subdivided and several small cracks occurred *en échelon*. These were blocked by snow at no great depth from the surface. Several small streams were pouring down into them, but it was impossible to decide if they were melting their way through the frozen snow bridges (*Böden*). Icicles hung from the sides in great profusion, all with water dripping from their points.

The backwall of the corrie consisted of buttresses of rock alternating with gullies occupied by a thin covering of ice and snow. In early summer the surface snow avalanched off these gullies on to the glacier below, forming fans of snow accumulation. A rock outcrop projected immediately above these fans and may be regarded as marking the upward limit of the glacier. The face of this rock rose perpendicularly above the glacier and was found to be rotten and frost shattered; below the level of the névé it was slightly undermined. A small randkluft[1] was occasionally found. It was about 8 inches wide, but narrowed downwards, and 1 foot below the surface it was blocked by loose fragments of rock frozen together. No water was present. The lower part of the rockwall in the randkluft was covered by a thin sheet of clear ice which was not in contact with the wall but was slightly removed from it. It suggested the following sequence of events. A thin sheet of water passing over the surface had frozen during a colder spell, covering the backwall with a sheet of ice. During a subsequent warm period a thin film of water of smaller volume began to flow again, possibly issuing from a joint plane in the rocks. This melted the ice in immediate contact with the wall and left only the outer portion, resembling an inverted curtain. This latter supply of water had then ceased, either due to a change in the position of the stream or to the exhaustion of the source. It is doubtful if the cessation was due to a fall in temperature to below 32°, for if this had happened, a second sheet of ice should have existed. This observation seems to indicate that not only do melt-water streams cease or dwindle in cold weather but they may alter their position in warm weather.

The rockwall was examined again at the end of August. Melting had removed about 2 feet of snow, and bare ice was now exposed at the surface. The randkluft was only an inch or so wide and was blocked by frozen material. Most of it was dry, but at one point examined it contained water which trickled out on to the surface of the glacier in a small stream about half an inch wide.

Streams were found flowing down the snow gullies, which fed the glacier. These streams emerged from beneath the snow where it passed through the limestone crags above the glacier. They flowed for a few yards on the bare rock without having notched it in any way, before passing under the snow of the fan below. Their courses were marked by angular boulders most of which

[1] Odell (*op. cit.*, p. 247) has described the randkluft as the marginal crevasse which separates the moving névé of a corrie glacier from the cliff which overlooked it.

On the other hand, the bergschrund is the crevasse or series of crevasses which separates the moving glacier from the apparently motionless névé.

were very small, but one or two occurred as much as 1 foot in diameter. There was no randkluft to receive the waters of these streams, and thus they must find their way to the base of the glacier by plunging into the bergschrund. Climbing up the backwall, which sloped at an angle of 35° 20′, it was found that the ice in the gullies was thin and showed no sign of movement. Many small streams could be heard beneath their surface, even within a few feet of the summit.

The bergschrund of the MacLeod corrie consisted of several small cracks *en échelon* and, where these were uncovered, it was possible to descend some 20 feet into one of them. The plane of the crevasse sloped away from the vertical and leant outwards from the headwall as if some sagging had occurred. Dirt and snow covered both faces of the crevasse. Behind this material the upper wall consisted of a solid sheet of ice in which were embedded so many stones that it resembled more a mass of frozen scree than a true glacier. Above the crevasse the surface of the glacier was covered by scree; and the material embedded in the ice, as seen in the bergschrund, is probably derived in some way from this surface material. Below a depth of 25 feet the ice appeared to be clear, and the transition between this and the stone-filled ice above was sudden. The air temperature at a depth of 25 feet was 32° F. Several small streams emerged from the base of the snow on the far side of the crevasse and poured into it. A snow-bridge occurred 25 feet below the surface in the open part of the schrund, but where there was a surface snow-bridge the lower one was absent. The snow in the crevasse was frozen, which suggests that the air temperature at a depth of 25 feet in the crevasse does not rise above freezing-point. No streams were found below the surface snow-bridge although icicles existed profusely. Below a depth of 25 feet the schrund narrowed and curved under the upper side, so that it was impossible to see if it reached the rockwall.

Above this bergschrund series the backwall exhibited the features already observed in the North corrie. A large stream was cascading down it and appeared to be melting its way down the randkluft, as none of its water was flowing on to the surface of the glacier. A line of stones immediately below the stream leading down to the highest crevasse of the bergschrund suggested that recently the stream had been flowing on to the surface and into the bergschrund.

The corries of the Stubendorff mountains are larger, more precipitous, and deeper than those of the Campbell range. They are eroded into highly inclined gneiss and schists. Two were examined on the western face of the coastal mountains. The glacier of the more southerly one was fed by an ice-fall from the summit ice-cap. The bergschrund was narrow and filled by water, which was flowing out on to the surface of the glacier in a small channel in the ice. It was fed by water trickling into it from the glacier surface above. Stones and frozen material blocked the bergschrund 2 or 3 feet from the surface. In the northern corrie the bergschrund was larger. Frequently it was covered over; but, where it was open, a vertical as well as horizontal movement seemed to have depressed the lower side. At one point the upper wall stood 12–15 feet higher than the lower, and the crevasse formed a great open chasm, which was blocked by snow and frozen material at varying depths below the surface. In spite of its size the crevasse was not open down to the

rockwall. No melting was in progress. The air temperature was about 36° F., and the temperature in the crevasse at a depth of about 6 feet was 33° F. Thus, assuming that there was a drop of 1° F. for every 280 feet of ascent, the temperature on the mountain summit 1500 feet higher must have been below freezing-point. This suggestion is supported by the fact that it was snowing and the snow was settling on the summit of the mountain. Yet a large stream was cascading down the backwall of the corrie from the base of the summit ice-cap, and there seems to be a considerable time lag before atmospheric changes can affect the lower region of a glacier or snow covering in these latitudes. This stream seemed to melt its way down between the glacier and the rock; it certainly did not flow out on to the surface of the ice. A similar stream was found tumbling down the headwall of the other corrie, but numerous small streams were also present; some of the smallest probably flowed on to the surface of the glacier and supplied the moisture for the water-filled bergschrund. Above the bergschrund and at the sides of the glaciers the

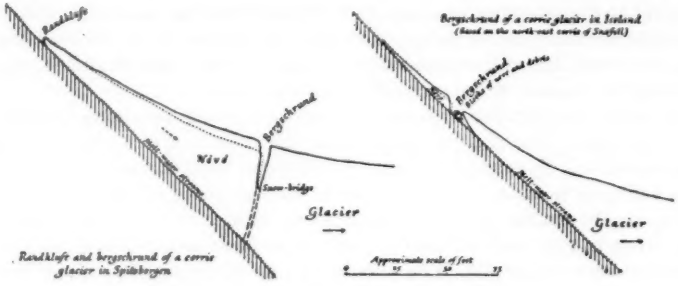


Fig. 5

ice abutted against the rockwall. Usually it was separated by a shallow randkluft, about 1 inch wide, which was frequently filled by water and was blocked by loose thawed material.

Conclusion. There can be no doubt that the headwall of a glacier-filled corrie retreats rapidly. The similarity between the supra-glacial and sub-glacial faces of the rock as seen in many British corries makes it clear that both surfaces are due to similar denuding agents.

In Spitsbergen the bergschrunds were usually small and ill-developed, covered or blocked by snow and frozen material. It is clear from this fact and from the temperature observations that warm air cannot penetrate to the base of the bergschrund.

We found that streams were abundant down the headwalls of the corries and they seldom flowed on to the surface of the glacier. Most of them melted their way behind the névé or plunged into the bergschrund. All evidence pointed to the fact that the warmth of the falling water thawed any ice which might cover the wall or be contained in the crevices of the rock over which it fell. If the stream were to cease through a fall in temperature, the water in the crevices would refreeze and a thin sheet of ice would form over the

wet surface of the rock. Such a sheet was never found above the level of the glacier surface, but was frequent in the randkluft and was well seen in an ice cave, in which the rockwall was exposed, underneath one of the ice-falls on Mount Robert. Thus where melt-water streams have access to the rockwall, the rock must suffer severe frost shattering.

The randkluft when present was extremely small and appeared to be only a surface phenomenon, yet streams seemed to be able to melt their way between the névé and the rockwall and so continue their descent to the base of the glacier. The rockwall was not found exposed in any of the bergschrunds, so that water pouring into them cannot affect the rock behind the névé, where however erosion must take place. Therefore the randkluft, in spite of its apparent insignificance, must be a very important factor in corrie erosion in Spitsbergen, since it enables water to reach the rockwall behind the névé (in Iceland the bergschrund was frequently open to the rockwall), which was exposed a few feet below the mouth of the crevasse; the schrund separated the moving ice from the headwall rather than from the stationary névé. Thus the relative importance of these two features varies in corries of different topographic form and in different climatic conditions. Both aid melt-water to reach the base of the glacier at or above the bergschrund, and the randkluft gives it access to the rockwall beneath the névé.

A fall in temperature to below freezing-point requires a long interval of time, probably several days, before it can affect the base of a glacier or large snow-patch in Spitsbergen, where the range of temperature in summer is not sufficient to cause much variation in the volume of a large stream. The effect on the smaller streams and sheets of water may be greater. Many of the streams were not confined to definite channels and probably they alter their position frequently. This should lead to refreezing of moisture in the original stream channel, as in the case when the stream has ceased through a fall in temperature. Thus the rockwall appears to suffer frost action below the level of the glacier surface both through the periodic cessation and the shift of melt-water streams which melt their way behind the glacier. This process, as in the case of nivation, will be most active in spring and autumn.

It is easy to understand how in Iceland the material loosened by freeze and thaw is removed from the headwall, since it can fall forward into the bergschrund or is gripped by the moving glacier. It is difficult to explain how in the Spitsbergen corries the material loosened by freeze and thaw underneath the motionless névé can be removed. If it is presumed that a slow but steady downhill creep of the névé takes place, the difficulty is diminished. Movement may be expected in summer rather than in winter, yet no convincing evidence of any movement away from the backwall was found; the randkluft was usually blocked by frozen material and did not suggest that the ice or névé had moved forward. A possible sequence of events is that névé moves and any thawed and loose material will move forward with it. The gap left will refill with water, fresh material will fall into it, and thus the kluft will be kept apparently closed. In this way the frost-shattered debris may be removed and one might expect the ice or névé above the bergschrund to be full of material, as indeed it is in the outer MacLeod corrie. This was the only case in which an extensive amount of material was

found, though other examples showed a certain amount, usually only small isolated stones, so that this process may well take place.

All the corries visited were intimately related to the structure of the region in which they occurred. Both in the Campbell range and in the Stubendorff mountains the floors of the corries were determined by a platform of more resistant strata, and the corries of the Stubendorff mountains were clearly eroded along lines of weakness due to faults. This fact is of considerable interest in view of the prevailing opinion that the topographic form of glaciated mountains bears little relation to their structure.[1] Thus, presuming that the corries were initiated during a period of oncoming glaciation, it seems that structure was more important in deciding their form, orientation, and location than climatic considerations. During the amelioration of climate, shade and the direction of moisture-bearing winds have become of increasing importance in the location of the glaciers. As the glaciers diminish, shade has become the most important factor in deciding the final refuge of the shrinking ice masses.

Finally the topographic features of the Campbell range emphasize the importance of corrie erosion and illustrate the various stages in the cycle of mountain glaciation,[2] from the early stages seen in incipient corries on the north-west face of the range to the partial obliteration of relief, as at the head of the Carron glacier.

[1] W. M. Davis, "Glacial erosion in North Wales," *Quart. J. geol. Soc. Lond.* 65 (1909) 285.
[2] W. H. Hobbs, *op. cit.*, p. 155.

SETTLEMENT AND LAND UTILIZATION, MALACCA

E. H. G. DOBBY

MALACCA has historical associations extending over nearly six centuries; this distinguishes it from the rest of the Malay Peninsula, which retains the characteristic landscape of a pioneer fringe.

The settlement began as a fourteenth-century refuge for Malays fleeing from Singapore and the south when these were attacked by Javanese. It received the rank of protected kingdom under Chinese suzerainty in the early fifteenth century and owed its perpetuation as a unit to Chinese control of the Siamese marauders who at various times overran most parts of the Peninsula. Chinese interest in the kingdom was primarily commercial even then, since the settlement had a small town, the meeting-place of traders from China, India, Arabia, and Java. The influence of Hindu merchants was considerable, but nearly obliterated by the later Chinese. Undoubtedly the growth of Malacca commercially at that time was an effect of the trade between the Far East and Europe *via* the Red Sea; hence the association with Arabs. It depended on outside contacts rather than on relations with the Malayan mainland, which threatened these overseas trade relations.

Portuguese navigators came to Malacca as part of their crusade against the Arabs, and Albuquerque captured the settlement solely to further the Portuguese policy of attacking the roots of Arab trade between Europe and the East. For nearly one hundred and fifty years the Portuguese held Malacca as one of the links in their chain of stations on the Asiatic seaboard. These could be held so long as the Portuguese dominated the sea, but, since Portuguese control led to no trade or economic development within its sphere of influence, the stations easily fell from their hands so soon as the Dutch and English arrived with equal skill at sea, and bringing with them trade facilities which always expanded the economy of the zones they touched.

The Dutch took Malacca from the Portuguese, with some difficulty, in the first half of the seventeenth century and, significant of changing values, found the sea approach too shallow for their larger ships. Yet Malacca was never prosperous under the Dutch, who were only interested in the tin production of the settlement and in possessing a strategic cover point for routes to their Sumatra and Java colonies. They even restricted agriculture in Malacca so that it should not interfere with Javanese production. Under them, Malacca was constantly endangered by Malay attacks from inland which kept the settlement in a state of armed anxiety; this uncertainty and the growing disadvantage of shallow sea diminished the commercial significance of Malacca.

It was taken by the British in 1795 when the Dutch colonial empire began to break up as a result of Napoleonic attack. Malacca fort, run by Dutch officials under a British Resident for a time, was thereafter used as a base for campaigns against Java and Sumatra when they were held by Napoleon's nominees. Malacca was restored to the Dutch after the fall of Napoleon, but later, in 1824, as the newly founded Singapore grew in prestige, Malacca became British in return for the cession of outposts of British influence on

Malacca river near Duyong

Cutting near Tanjong Kling, showing iron-pan

Malacca Malay house

Malay house of poorer type

Padang Kilang, surrounded by swamp and rubber plantations, with an empty stream bed running through it

the coast of Sumatra made to simplify the two colonial patterns. Thus while Malacca is the oldest European settlement in Malaya it is the youngest British one.

Throughout its chequered associations with European colonists Malacca retained a large Chinese population, partly linked by regular trade connections with China, partly permanent immigrants with a capacity to do manual work despite the climate and disease-ridden environments. Other trading settlements of the Peninsula were developed in many cases by these long-established Malacca Chinese; although newer settlements brought wealth to them, they frequently retired to Malacca, whose drowsy placidity distinguishes it from other towns in Malaya. The coming of rubber only temporarily renewed activity in Malacca, since as the rubber trade grew so did the export through Malacca within the limits of a disadvantageous coast.

In considering the geographical setting of Malacca in its historical aspect, it must be stressed that its development was more related to its position in south-east Asia than to local associations with Malaya. Until the period of rubber planting at the beginning of the present century, Malacca's hinterland was jungle with a few Malay villages in clearings along the watercourses. The town is situated on a hill convenient for fortification, on the one section of coast free from the offshore bars and swamps typical of most of west Malaya. As a harbour Malacca at no time had significance and the river was bridged practically at its mouth from earliest times, indicating that access to the river was no factor in its growth. Although the coast is shallow it has none of the alternating rocks and shifting sands found elsewhere, and may be called a neutral coast, since there is neither natural retreat nor natural advance of the sea at the present time. The situation halfway along the Peninsula and halfway from India to China made Malacca attractive to traders whose movement was invariably coastwise. Its value was as an entrepôt for Asia, serving the functions performed by Singapore to-day, but this value disappeared when shipping became too deep in draught to approach Malacca, and capable of long trade journeys over the open ocean. No significant ocean traffic touches Malacca to-day.

Malacca's coast runs N.W.–S.E. and the triangular settlement is roughly bounded by a latitudinal line along the Tinggi river to the north and by a longitudinal line following the Kesang river to the south, some 40 miles by 20 miles overall. These courses are flanked by broad swampy tracts subject to floods and therefore act as barriers to movement even to-day, as is shown by the ending of many roads towards the Tinggi and Kesang rivers.

No scientific analysis of the topography is possible since the settlement has no topographic map, although the adjoining states are fully surveyed for relief. The general impression is that the surface has two planes: first, broad flats of the valleys which rise very little above sea-level, even well towards the interior; secondly, higher land sloping from several hundred feet inland to little more than the 100-foot level at the coast. Extremely deep slopes separate these two levels so that the flat valleys have abrupt sides rising to the higher level. Towards the northern border a few granite monadnocks exceed 1000 feet.

Geologically Malacca is on the western flanks of one of the N.–S. granite ridges which lie in echelon across the Peninsula. Fragments of one ridge in advanced erosion form the few high hills of Inner Malacca. The belt of granite stretches to the southernmost 5 miles of coast and narrows to a waist near Jasin. Two small outlines of granite appear on the north coast near Sungei Baru. On either side of the granite are phyllites of a calcareous silicate type together with small quartzite and shale outcrops on the extreme north-west and south-east flanks of the granite. Two-thirds of the actual coast is of recent formation with shaly fragments or coarse marine sands. The geological sub-structure plays little part in the surface modelling or in the soil character: more important is the cover of weathered material which masks the solid geology to depths of 20–40 feet. This depth reflects the vigour of chemical erosion under combined high temperatures, heavy rainfalls, and strong humic acid run-off water, and the long geological period without serious change in this condition. The advanced stage of weathering causes the surface to have no visible relation to the solid geology except where solifluction on higher land thins the cover. Two broad categories must be distinguished in the cover material. On the higher plane, where relief creates easy drainage, the cover is lateritic with four distinct horizons visible in section:

1. A few inches of yellow surface soil containing roots; it may be nearly black beneath virgin forest, but quickly bleaches to yellow under cultivation.
2. Two to eight feet of reddish gravelly material consisting of broken iron-stone nodules, half an inch average length.
3. Twelve to eighteen inches of dull red, extremely resistant iron-pan which may be laminated or vesicular.
4. A bed of compact, red and yellow mottled clay up to 20 feet in thickness.

Such a section-type covers all geological formations where the surface topography is only lightly modulated: the panning seems related to a change of chemical balance in sub-surface water comparable to that in European podsolic types.

On the lower plane, associated invariably with the flat-bottomed river valleys, stagnant water and bad drainage are the chief surface controls, the soil being a heavy black clay of undetermined depth without any evidence of panning, no iron concretions, and no characteristics of laterite.

Two lines dominate the drainage pattern: principal streams flow roughly N.E.–S.W. controlled by the original anticlines of the Peninsula, while tributaries are arranged N.W.–S.E. Drainage is slow owing to the small fall; even the main streams meander in great loops over wide flood plains. The tidal range along the coast is of the order of 7 feet only, yet this suffices to affect the river drainage for as much as 10 miles inland and seriously impedes the run-off during the regular floods. Since the rainfall exceeds an average of 7 inches monthly, ample water would be expected in the streams; so much is diverted from them for rice irrigation that many valleys contain no visible stream. The flood plains are normally covered with water for periods which may total three months a year, with greatest flood risk in November. These floods are not seasonal however; they are often extremely localized as a result of the local torrential downpours. These last

only a few hours normally, despite their heaviness, and floods rarely continue for more than a week or so at a time in any one place. It is peculiar to the Malacca topography that rivers have difficulty in reaching the sea; they turn not far from the coast and run parallel to it for some distance. The great problem in face of flood risk therefore is to shorten the outlet to the sea by artificial channels and this is a common engineering device along the coast, *e.g.* the drainage of the lower Kesang and Malacca rivers.

According to all evidence floods have increased in this century and have been chiefly responsible for many old-established rice lands going out of cultivation until public drainage works reduce the risk. Floods have increased owing to the silting up of rivers well inland; soil rapidly washed into them under the early system of rubber planting which eliminated all vegetation except the rubber tree, leaving unbound soil at the mercy of violent showers. Soil erosion in Malacca has had an immediate effect on flood frequency. Hence drainage and increase in rice lands can go side by side only with increasing use of cover vegetation underneath the rubber trees and with dredging in the middle courses of streams to remove the recent silt.

Malacca's climate is equatorially monotonous. Its daily and seasonal temperatures only deviate from the annual average of 79° by 4 or 5°. Rainfall all the year is convectionally heavy (92 inches), but in showers of short duration between long sunshine periods. The main seasonal variation depends on a change of wind; a north-east wind blows regularly from November to March and a south-west wind from April to October. At the change-over of these winds the greatest atmospheric instability occurs, evidenced by the peak frequencies of thunderstorms and the greatest expectancies of rain. Malacca is noted for its "Sumatras," violent local squalls striking the mainland from the Straits during the season of south-westerlies. Emphatic land and sea breezes modify the immediate surface winds at all times, while the steep-sided valleys and tall trees on the ridges tend to damp down air movement, creating the breathless atmosphere for which Malacca is well known. The slight rain maxima of the change-over periods, roughly April and November, control the local farming rhythms.

Agriculture is more important in Malacca than elsewhere in Malaya; only about one-sixth of its surface remains in forest, whereas the Peninsula average is four-fifths. Agriculture here clearly falls into two classes: extensive farming of rubber and intensive farming of rice and minor crops.

Rubber occupies nearly 80 per cent. of the cultivated surface, but its importance in local life is not in this proportion; being essentially an extensive cultivation it makes less labour demand per unit area than any other farming activity. The labour occupied in rice moreover cannot satisfactorily be estimated, since that crop is "family cultivated," while rubber is cultivated by wage-labour on contract. Two-thirds of the rubber area is in large estates of over 100 acres each, but the average is about 1000 acres; these holdings are primarily foreign—Chinese, Indian, European—with Europeans controlling two-thirds of the large estate area. Labour on these estates is likewise foreign, principally Tamil-Indian and Chinese, and one labourer is employed to each 7 acres of rubber. Smallholdings of rubber, about a third of the rubber land

altogether, are held by Asiatics only; most of those in Malacca are Chinese owned.

Of the second class of agriculture, occupying the area not under rubber, one-half carries rice and the rest a miscellany of foodstuffs such as coconuts, fruits, and vegetables. This agriculture is essentially the activity of Malays, who are the owners and the cultivators; they operate on a family basis without recourse to employed labour. While by comparison with rubber it is an intensive agriculture in so far as it occupies many more people per unit area, yet it is not intensive in the sense that the land is cultivated all the time with intergrown and off-season crops as in southern China. By international standards the intensive agriculture of Malacca has an extremely poor yield, the quality is inferior, and the technical achievement low.

Prior to the introduction of rubber, rice was the principal cultivation and the rural economy revolved round that crop and a few spices. Rubber has completely changed the emphasis but not ousted the rice farmer; both the area and intensity of rice growing have remained much the same for several generations, while rubber is grown on land previously uncultivated. It has added to the economy without changing the basic agriculture and methods on which the original native Malays were living.

The two types of agriculture do not trespass on one another for area except where the ignorance of a peasant forces cultivation on a patch radically unsuited for it; rubber forced on old rice land grows because the tree is hardy, but yields practically no rubber. Rubber estates occupy the higher, well-drained surface, rice is confined to the flats of flood plains, and the minor food crops lie along the marginal zones between these two or on the sandy soils of the immediate coast. Rice and rubber demand such different environments that there is no fear of either ousting the other. Since rubber production is restricted and since the tree takes long to mature and reflects a crisis only after eight years, rubber acreage remains fairly constant now, tending, if anything, to decline, while the rice area steadily expands as flood control increases. For political reasons rice cultivation receives active official encouragement.

In the non-rubber area the unit of cultivation is very small. Over a sample area of a third of a square mile near Tanjong Kling, a rice and minor crop zone, three-quarters of the holdings were less than half an acre each. A house generally possesses some 3 acres held by the various occupants; as will be shown later, possession in this case does not mean freehold control. The feature, then, of Malacca food agriculture is the minute scale of operation in contrast with the large scale of production of rubber for commerce; the rice and minor crops play a greater part in rural life than the rubber which is cultivated by "outsiders" for use outside the country. Three times as many people depend directly on small-scale farming as on rubber, irrespective of the large area it occupies.

All agricultural work by the rural Malays is on a small scale; their farming instruments are very simple, generally made locally and of wood. Rice land is frequently never ploughed at all, the work being done by *changkul*, the Malay adze-like hoe. More care is given to raking, which reduces the flooded surface to the fine mud necessary for rice; the rake makes a more regular surface and

facilitates that accurate levelling needed to retain flood water. Many rice growers possess one buffalo for ploughing, raking, and for draught; it is lamentable that manure of these buffaloes is never conserved and applied to the padi-fields; ground or burnt bone is the conventional manure where used at all, but the attitude to cultivation is free and easy, so that manuring is not universal. When officials distribute free high-grade rice seeds to yield three times the Malay average, the reaction is to sow only one-third the area. Malay rice quality is low and poorly esteemed by dealers. Unfortunately, although drainage and irrigation schemes have increased the area of reliable rice land, the new areas are only slowly taken up, since Malacca Malays are quite satisfied to feed on what they cultivate already; other ethnic groups have not so far been permitted to take up rice cultivation.

Malay smallholders have an almost self-contained economy; they have few requirements beyond rice, fruits, coconuts, and spices which almost grow themselves round the house, and an odd chicken or goat. Their diet is nearly vegetarian, but fish is frequently available without purchase from the sea and streams. Hence the need for money is small, met either by doing odd jobs during the rice off-season or by selling the yield of a few dozen rubber trees. Those with a few rubber trees in addition to their rice have no necessity to work for a cash margin since the restriction scheme gives them a "coupon" permitting them a rubber quota and they sell the coupon to a high-grade rubber estate, leaving their own rubber trees standing untapped for years.

By higher latitude standards Malacca has no seasons, but rice farming closely adjusts itself to minor rhythms in the yearly weather. Rice is set out in time to benefit from the rain maxima of April and November and the natural floods they bring. Only a limited area has been brought under modern irrigation as yet, and Malays never developed good small-scale irrigation systems of their own, so that they depend principally on natural spates on their saucer-shaped fields. For this reason their crops are irregular in quality and quantity. There are two occasions each year when sowing may be done, but smallholders do not attempt two sowings a year although such a system has no natural impediment in Malacca. Early August is preferred for rice planting.

The rice required by urban Chinese and estate labourers is imported from Siam or Burma. Malacca rice hardly ever moves from the farm where it is produced, so that all processes from harvesting onwards remain simple: cutting is done by hand with a knife some 18 inches long; the ear is removed by hand without flailing. Grain is frequently stored in the ear until required and then it is treated a few handfuls at a time. Husking is done by passing rice through the *kisau*, a small hand apparatus working on the principle of a grindstone; the revolving surfaces are of wooden strips fixed in clay which rub the husk from the grain. The wood and clay surfaces are set in a wicker basket-like container and are turned by pushing to and fro a rod which imparts a circular motion after the style of piston and fly-wheel. The mixed grain and chaff from the *kisau* passes then through the *indik*, a foot-operated wooden hammer whose head falls into a wooden socket where the mixture is pounded to polish the grain. Finally the grain and chaff are winnowed from day to day as needed; women toss the mixture in a plate-like wicker *tampi* which separates

the grain, assisted by blowing while tossing. When rice dough is wanted for the Malay equivalent of spaghetti, it is made by soaking the grains and then pounding them to a smooth paste.

After rice in importance is coconut, which, in Malacca, does not enter commerce. Coconut palms are set round every house and provide the staple oil for domestic use in cooking. Commercial copra production is unknown; the only continuous coconut plantations are set out close to the sea north-west of Tanjong Kling, and these are for local sale alone.

Market gardening and minor crops of intensive cultivation are almost exclusively in the hands of Chinese smallholders, who introduce their own methods. Their holdings are always in crop; several crops may be present in different stages at the same time; in addition to burnt leaves, human manure is regularly applied even though health authorities discourage the practice. Malacca Chinese by their skill get crops which no other community can profitably tackle; they have been peculiarly successful with tobacco, for example, which owing to the care and labour required in the Malayan climate can never be anything but a smallholder's crop, yet its acreage doubled to 800 during the two years ending 1938. Characteristic of the Chinese farmer is pig-keeping; the success of the Chinese smallholder is to be attributed more to conservation and use of pig manure than to any other separate factor. Malays are not accustomed to animal farming, never use buffalo manure because the animals always roam loose, and they object on religious grounds to pigs even though the pig would produce money and raise the grade of their farming. Chinese smallholders produce for sale; they cannot live directly upon their produce; they respond very quickly to expert suggestion and to changing demands of the market, but they have been debarred so far from cultivating rice where their technique would admittedly improve the standard of cultivation. The policy has been that, since Malays are natives and Chinese immigrants, Malays must be encouraged to preserve their own ways and protected from competition, though this perpetuates inefficiency.

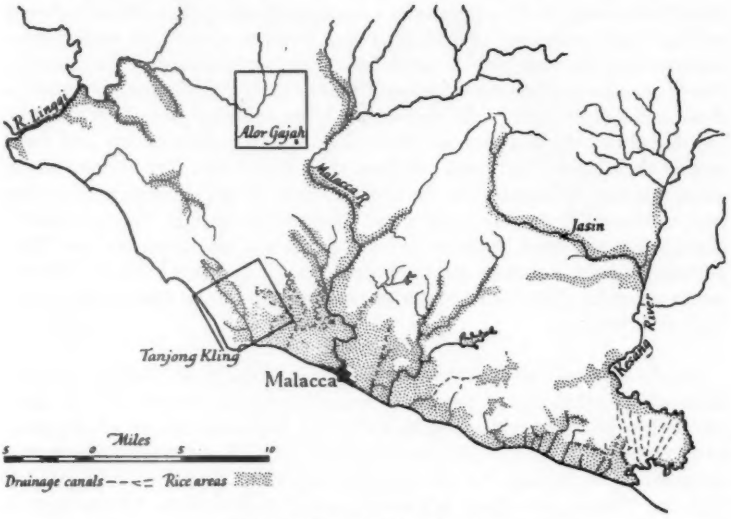
Under my direction two land utilization surveys were made on a scale 3 inches to the mile in two sample areas of about 13 square miles each, chosen to represent coastal and inland conditions.

The overwhelming significance of rubber and rice on the cultivated landscape was unmistakable; other cultivations were almost unmappable because they were mainly confined to a few square yards surrounding the houses or as dividing lines between other cultivations. The coastal sample, near Tanjong Kling, repeated one feature found in the inland sample, near Alor Gajah; the chief pattern is the riverine flood plain, under rice, and the rest under rubber. Only on coastal marine sands were continuous coconut plantations found. The Alor Gajah survey covered an area where the sub-structure represented the three distinctive rock types of Malacca, granite, phyllite, and quartzitic shales; but no correlation with these geological differences can be seen in the agriculture. Closer examination showed the same immediate surface soil over each rock, differing only in the flood plains.

No crop but rice stands the tenacious clay soil of the valleys and profits by the sodden surface it assumes during storms. Only after draining these flats

can controlled water be of use to farming, so that irrigation succeeds drainage in Malacca. It may seem strange that irrigation should be necessary under a rainfall of 92 inches annually; the explanation is the unreliability of the fall and because at certain stages rice needs the equivalent of 20 inches of rain per month. Malays never perfected irrigation beyond putting faggots across streams to divert a little water locally, leaving the original channel as a drain for the fields. Production in these fields depends more upon water than on plant foods in the soil.

Outside the flood plain, the agricultural value of the land depends on the previous biological history of the soil more than on different mineral constitution. If the soil is new, just cleared from virgin forest, it will be too sour and



Rice cultivation in Malacca

overweighted with humic acid for good crop yields; occasional patches in it may have high fertility where some dead forest tree was rotting for years past. If the previous cover was rubber kept on a clean-weeded surface, then all organic and soluble elements will be absent because of the alternations of severe baking and drenching. There is a condition between these extremes which is the optimum for plant growth, but to retain the optimum condition is a matter of delicate biotic balance to counteract the rapid leaching. Such a balance is too difficult for unscientific managers of plantations and for the average smallholder, though Chinese smallholders achieve it if they settle permanently on land. Owing to the ease with which all virtue can be removed from this soil and to the slow rate of natural replacement under equatorial conditions, close watch has to be kept on temporary occupiers of land on very short leases. Chinese immigrant squatters were in the habit of growing tapioca and then moving on to another site, until it was found that tapioca cripples the

soil far more than any other Malayan crop and implied a long period before it could be coaxed back to conditions suitable for other cultivation. There is a great contrast between the conventional description of "luxuriant equatorial vegetation" and the actual soil poverty from the cultivation point of view. Commercial crops here are only possible by constant labour and application of plant foods and manures, treating the soil as a nearly neutral medium rather than as basic store of elements available for plants.

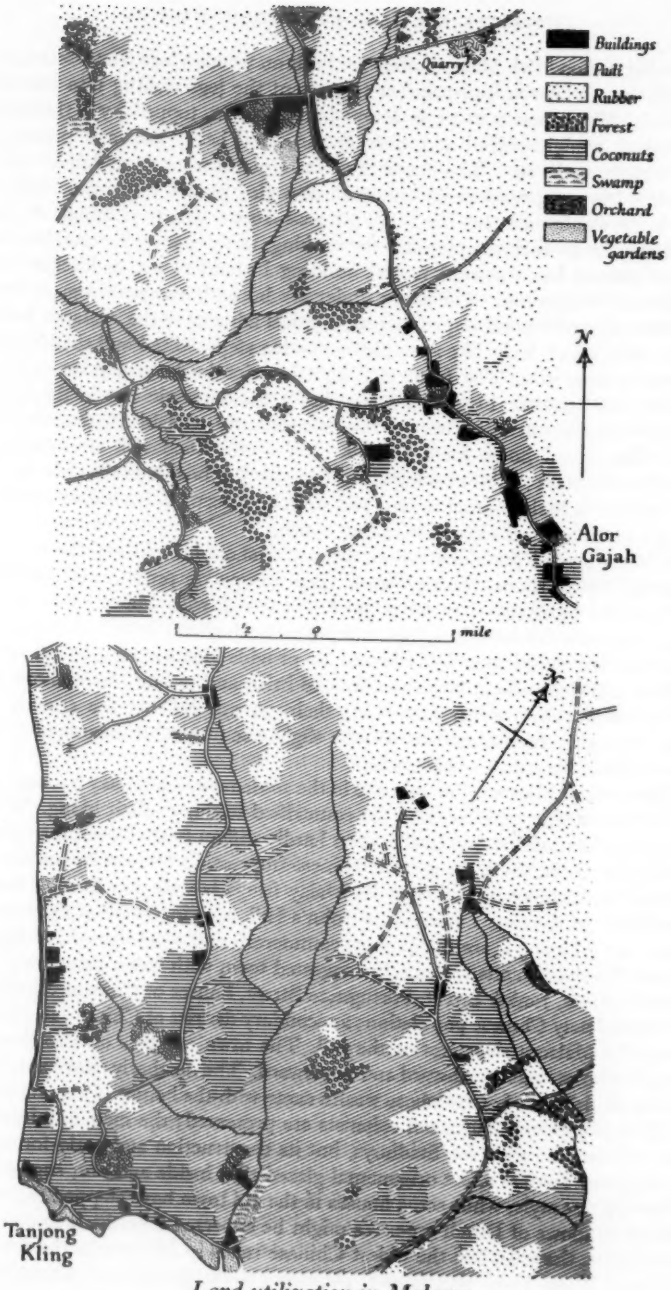
Mining has no present importance in Malacca, though various old alluvial tin mines in the Kesang valley show that tin attracted the early colonists.

Fish is prominent in both Malay and Chinese diet, and there are easy fishing facilities on the Malacca coast. The activity is more Malay here than is normal in Malaya, and the villages primarily interested stand on the northern half of the coast. It is emphatically a small-scale occupation, based on small sailing boats averaging 10 feet long and hence restricted to seine-fishing inshore. For the most part the catch serves the local people only and averages barely $1\frac{1}{2}$ tons per fisherman per year. Customarily the fish unsold locally are dried and fishermen consider themselves lucky to make 30 cents Straits (9*d*) per day above the fish they eat themselves. They grow coconuts and fruits among their houses, but must purchase their staple rice. The women weave palm-leaf mats to supplement the income. Prawns and shrimps form a large part of the catch and are made into "Malacca cheese," or *blachan*; shelled shrimps are sun-dried, pounded to a paste with salt, rolled into fist-size balls, enclosed in palm-leaf cases and further dried until the paste hardens. *Blachan* meets a regular demand in Malay curry diet and can be transported easily because it keeps.

Nearly a quarter of a million people live in Malacca Settlement, giving a density higher than that of any other Peninsula unit. About one-fifth of these people live in Malacca town, so that the area is essentially one of dispersed rural population; centres like Jasin and Alor Gajah are mere villages of a thousand or so persons. Of the population, Malays form half, a proportion high for Malaya; one-third is Chinese, one-eighth Indian. Malays form a large majority in the rural area, while towns and villages are predominantly Chinese. Indians concentrate on the large rubber estates, where they work and live isolated by distance from other communities. The percentage of Chinese working land directly is small, though their activity may have future significance.

The buildings imposed on the landscape reflect the mixed population of Malacca and the different foreign influences of the past, subdued by the equatorial environment.

Over the rural area Malay house-forms predominate, built flimsily of local material. Houses are situated just off the flat flood plains of streams where flood risk is less, so that while Malay villages have an amorphous shape houses tend to scatter in lines on the margins of padifields. Villages, the Malay *kampongs*, are never compact because each house is set round by coconuts and fruit trees whose foliage gives shade and the impression of settlement in a forest. The same village name may cover house-groups separated by a mile or so of unpeopled padifields.



Land utilization in Malacca

Owing to flood risk Malay houses are built on wooden legs 5 or 6 feet high, which rest on laterite iron-pan feet to prevent the legs sinking into the soft ground. The superstructure is everywhere wooden, topped by a thatch of palm-leaf, straight-ridged and steep to throw off heavy rain and present a small angle to the sun. The single floor has a platform or verandah in front, which is less an appendage and more an unwalled part of the house. Behind this is the single room serving every purpose from eating to sleeping. At the back may be an enclosed platform for cooking, in the poorer houses, but the better pattern has a second roofed building beyond to act as kitchen and additional living-room. The space under the house between its legs accommodates all agricultural impedimenta. Typical adjunct to the Malacca house is the *kewi*, which looks like a couple of wooden steps, stilted and thatched; it serves to store rice. The front step contains rice husks and poor rice for buffalo feed, and the bigger back step holds the domestic rice in the husk. Only rice needs storing; other produce is constantly available direct from the tree. The stilted house-form persists even where flood risk is negligible. Interiors are stark; palm matting spread on the floorboards is the only furniture on which Malays squat to feed and stretch to sleep. Customarily families of two or three generations live in one house.

At certain road junctions are set the rural shopping-places; the normal *kampong* has no shops. Though these shop groups are prominently mapped and easy to recognize they must not be confused with Malay settlements. They are quite different in layout and purpose; they consist of a dozen or so open-fronted shops kept by Chinese to provide the country people with clothes and a few minor luxuries. Built of brick and plaster, these shops are rarely more than twenty years old; their growth reflects the coming of wage-labour to the rubber estates and a slight rise in rural standards of living since rubber became a staple trade.

The town of Malacca, the only one in the settlement, has Malay houses only on the fringe where Malays find the countrified setting to their liking. While the proportion of Chinese in the town hardly differs from that in the settlement as a whole, the town gives a Chinese impression because its nucleus is exclusively Chinese even though its Malay fringe is well populated. Immediately left of the river mouth is St. John's Hill, carrying ruins of the Portuguese fort; skirting it are the modern commercial and administrative centres. Across the river stands the closely congested town with historical names like Heeren Street, Jonker Street, Portuguese Street, houses of Chinese character and completely Chinese population; a secondary district of Chinese shops lies along the Malacca river east of the hill. The town expands on two lines—along the coast roads northward and southward. The northerly road has a long ribbon of elaborate houses whose wealth came with the booms of this century.

Signs of previous European colonists are preserved; the main administration building is called the Stadhuys, but its construction and patio-form are Portuguese. Houses affect ornamental glazed tiles inside and out, suggestive of Portuguese style, while some houses in the old town have stepped roof and cowled windows of Dutch type. As might be expected from its long contact with China, the town has the oldest Chinese relics in Malaya, in the temple of Cheng Hoon Teng, significantly dedicated to the goddess of navigation.

Among Malays, as among other tropical Asiatics, one effect of contact between their self-sufficing economy and the commercial money system is the tendency to become chronically in debt. Aggravating this, Malacca Malay holdings have every symptom of under-cultivation and lax working; on the other hand the extremely small holdings suggest that Malacca foodcrop land is over-populated. Pulverization of the padi land is surprising, since Malays may occupy and use land without premium and the padi rental is only *2s 4d* per acre annually. It seems that the Malays have been so long overwhelmed by natural conditions beyond control of their technique that they have lost the capacity and desire to profit by the superior methods now available to them. They show little interest in profiting from the demand for rice among Chinese and Indian immigrants.

To prevent Malay indebtedness and its evils in smallholding communities the settlement has established rural credit cooperatives on the pattern of those in India, with the difference that Malacca cooperatives are not permitted to borrow beyond their own subscribed funds and are therefore self-contained. No system of cooperative purchasing or marketing has been found workable, for the Malay smallholders will not forgo immediate advantage for the sake of ultimate benefits.

Several systems of land tenure operate and represent effects of different administrative influences. In general the Malay custom has been retained; under this, rights in virgin forest were vested in the ruler, while land cleared and occupied by cultivators gave them the right to it and its transfer by payment of one-tenth of the produce to the ruler. All land held by Malays, nearly three-eighths of Malacca, is held on this basis, with the tithe commuted into a fixed rent graded according to the crop. Malays still have the right to clear virgin land without premium if they will cultivate; clearing for any other purpose is strictly controlled and letting of rights closely limited. Virgin forests are Crown rights and these have been transferred on leases and grants for premium and rent, the tenure under which the majority of rubber land is held. In Malacca there is no question of displacing or expropriating land from native cultivators. Only the initial advantage of great stretches of virgin forest made it possible for commercialized cultivation to develop here without ousting any one, and made it possible for two radically different systems of agricultural economy to continue freely side by side.

In the north-east among Malay farmers are remnants of a system of inheritance through women which is pre-Muhammadan. This custom, limited to Alor Gajah and Jasin districts which were part of the medieval independency, Naning, is called either *adat naning* (custom of the Nanings) or *menang kabwa*, after a district name in west Sumatra, whence presumably Malaysian immigrants brought it. The custom coexists with a *naning* dialect; all land goes to the eldest daughter, subject to a small distribution of money to sons; failing a daughter, inheritance goes to the nearest female relative.

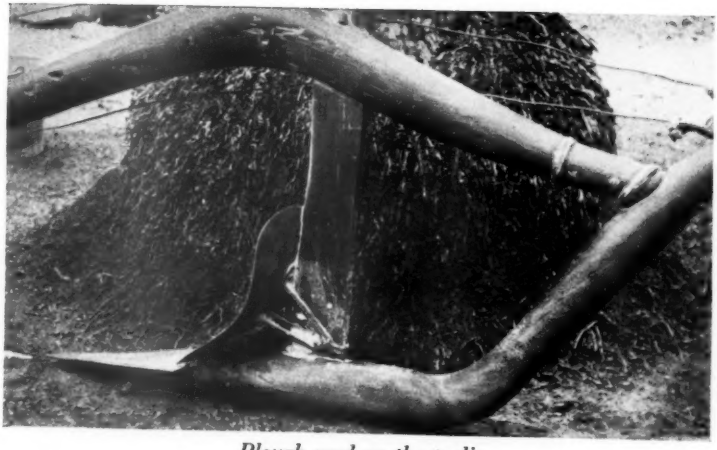
Freehold land, without obligation to pay rental, is very limited in area and dates mainly from the Dutch period. To encourage but control other smallholders, temporary occupation licences are issued yearly at rent varying with the crop; on these the Chinese smallholder makes his experiments which may ultimately change the character of food production in Malacca.

On the map the settlement stands out for its density of roads by comparison with the adjoining states. These are unrelated to the long history of Malacca and date from its development under the British. Yet the natural impediments, which isolated Malacca from its surroundings landward and protected its early development, now react unfavourably: the coastal road system, for example, is broken by ferries across the broad rivers near the Johore and Negri Sembilan borders. Hence the main arteries of communication in Malaya merely fringe Malacca in its extreme eastern borders, while the centre of gravity of population and activity is primarily coastal. Malacca only links to the railway system by a branch line with a restricted service; transport of goods and passengers from adjoining states is by road. The volume of all traffic is small because the neighbouring areas produce much the same commodities and cannot make up their food deficiency from Malacca. Rubber to the extent of some 2500 tons monthly moves from Johore and Negri Sembilan to Malacca for export.

Malacca trade still moves by sea; the primary commodities to and from the colony are transported in ships coastwise. Major ocean-going vessels never touch Malacca owing to the lack of harbourage. Even tramp steamers must anchor well out and handle goods by lighters or Chinese sampans. Any improvement is prevented by the two jetties which carry the river a third of a mile to sea; these were built when it was mistakenly thought that silting in the upper Malacca river was due to congestion of marine alluvium at the mouth. One effect of these jetties has been to increase silting on the southern side, hastened by infilling and reclamation work.

The seaborne trade is emphatically one-sided; exports are four times the imports by value and the disproportion by weight is even greater. Over 90 per cent. of the export is rubber; three-quarters of the import is rice from Siam and Burma. These commodities move mainly *via* Singapore in Chinese junks or small steamers. Hence, though Malacca gives three-quarters of its bills of lading to the United States of America, the rubber always tranships at Singapore; 80 per cent. of Malacca's rice similarly tranships on its way from Siam. Malacca itself provides half the rubber it exports, and an increasing proportion moves in drums as liquid. In the rubber movement there is no seasonal character.

In summary, Malacca represents an example of changing values, since from being a focus of the East it has become a backwater, and of interlocking agricultural economies, the self-sufficing Malay and the money-cropping by Europeans and Chinese.



Plough used on the padi

Buffalo rake for the padi

Pounding rice in the indik

The kisau, for husking rice

1. Sprit-sailed boat, Igdlorssuit

2. Igdlorssuit dory

3. Killick, Igdlorssuit

4. Godthaab dory

BOATS AND SAILING CONDITIONS IN UMANAK FJORD AND THE VAIGAT

D. M. CARMICHAEL

THE force and direction of winds in Umanak Fjord and Disko Bay are determined mainly by the proximity, track, and intensity of cyclonic disturbances passing up Baffin Bay in an easterly or north-easterly direction. On the coast-line proper—on the west of Disko, at Nugssuaq and at Svartenhuk and sometimes as far in as the west coast of Ubekendt Island—such disturbances are generally accompanied by strong winds from any point between S.E. through S. to S.W. according to the track of the storm-centre. At Igdlorssuit it was noted that, while the wind at sea-level is S.S.E., the cloud drift is often from the S.W. Between the outermost islands and the head of the fjords, on the other hand, although storms of this type are commonly referred to as "south-westerly," extraordinary variations in wind direction and force have to be reckoned with. Associated with the passing of the depression, a strong current of air blows off the ice-cap. In all the Umanak fjords therefore from Qarajaqs Isfjord to Kangerdluk, according to the direction of each, the wind varies from S.E. through E. to E.N.E., and extends far into Umanak Fjord proper, blowing most strongly along the north coast of Nugssuaq peninsula, and at the junction of two or more fjords. Off the south-east corner of Ubekendt Island, and again in the lee of Upernivik, there is generally a heavy swell with little wind, but in the western half of Igdlorssuit Sund the full force of the wind, now blowing from the S.S.E., is encountered. On the east of Upernivik Island the wind blows in for a short distance at each end of the strait Inukavsait, leaving a calm area in the middle. In the Vaigat also, especially when the wind outside is W.S.W., a calm patch occurs, generally north of Qutdligssat, and for that reason sailing ships bound north from Disko Bay used to keep outside Disko. An easterly wind in the Vaigat reaches its greatest velocity in the narrows between the precipitous mountains of Disko and Nugssuaq.

The only winds other than those described which occur at all frequently on the coasts of North Greenland are northerly. A north wind blows into the Vaigat and all the Umanak fjords, with the exception of two in the north—Ingia Fjord and the dangerous Uvkusigssat Fjord. Out of the second it blows in such vicious squalls that all Greenlanders dread the place.

From 29 June until 8 September 1939, northerly winds were experienced at Igdlorssuit on ten days, but never for a period exceeding twelve hours, and only once did the wind attain the force of a moderate breeze. "South-westerly" storms of considerable intensity, on the other hand, were uncommonly frequent. The seas then encountered were short, steep, and awkward, but not dangerous to a fully-decked boat except at the mouth of the Vaigat, where strong tides run.

It was noted at Igdlorssuit, and again during the autumn at Umanak, that while the barometer is falling, calm conditions or light northerly winds prevail. The wind off the ice-cap comes, often very suddenly, when the barometer begins to rise, but sufficient warning is always given by the piling up of high tower-like clouds over the edge of the inland ice. These clouds are

built up of many thin, horizontal layers, and their bright, shiny edges indicate the drying caused by the rapid descent of the air to sea-level. This rapid descent often produces a typical föhn wind (warm, dry, and gusty), which may reach gale force in squalls and then, for a time, fall very light.

After the end of June, fogs so dense as seriously to impede navigation are rare in Umanak Fjord east of a line from Nugssuaq to the south-east corner of Svartenhuk. When visibility is poor, Greenlanders in charge of motor boats depend largely on previously memorized compass-courses.

On the main routes between the settlements icebergs are no real hindrance to navigation, but in the fjords below the great glaciers and round islands blocking the entrance to these fjords, such as Qeqertarssuaq and Karrat, great congestion occurs. The best chance of finding a passage through a mass of large and closely packed bergs is in shallow water close inshore.

Icebergs and floating lumps of calf-ice (except for the so-called "black-ice") can generally be seen in good time even on a dark night. If the look-out in the bows is equipped with a powerful electric torch, a motor boat can travel up to 8 knots with almost perfect safety. The torch is used both for sweeping the water ahead and for signalling to the helmsman. Hitting a lump of calf-ice with a strongly built motor boat is more likely to injure the propeller than the hull. Forcing a way through the thin sheet of new ice, which forms so rapidly over the fjords in the late autumn, will however quickly cut into a boat's planking, and copper sheathing is then essential.

In exposed anchorages such as Igdlorssuit and Qutdligssat, small icebergs, moving fast with wind and tide, can be a nuisance, and boats at anchor have to be watched continuously. The prevailing east wind often fills Umanak's main harbour with ice, which, if heavy, forces motor boats and even schooners to use the anchorage, Spraglebugt, on the west of the island.

The maps of the Danish Geodetic Survey indicate where vessels may lie, a distinction being made between harbours (anchorages) suitable for all kinds of craft in all weathers, and boat-harbours. First of all with the help of Dr. Porsild, who has a magnificent record of successful and extensive cruises in Greenland waters, and later from personal experience gained in the course of the summer, some additional boat-harbours were noted in Umanak Fjord and the Vaigat, and some corrections made in the positions of those already shown.

A boat-harbour may be anything from an open beach to a small but well-sheltered natural harbour, such as Qeqertaq, north of Sagdleq; and as no soundings are given, nor any indication of the kind of holding, the following notes on some individual anchorages may be of interest.

Svartenhuk: Good holding and good shelter in northerly winds in the bay east of Kap Cranstown, and at many places along the south shore of the peninsula—especially between the *rejsehus* and the *fangsthus* on each side of Akunerit.

Schades Öer: A well-protected little anchorage among the islands, immediately south of the main island, Angineq.

Igdlorssuit: Not a good anchorage. It is exposed to the north, and the steepness of the beach renders the holding very insecure, and allows heavy ice close inshore. The 1½–2-knot tide which sweeps round the bay carries this ice with it in a manner highly dangerous to small boats and their moor-

ings, while in an on-shore wind all boats have either to be beached or to clear out. Schooners and motor boats usually anchor off the pier, and bring a hawser ashore to the rings provided. This is the most convenient but not the safest spot. Better holding and better shelter, especially in northerly winds, is to be found on a bank extending for some distance offshore, a little way

Harbours and boat-harbours, Umanak Fjord and the Vaigat

north of the most northerly house in the settlement. During strong northerly winds however it is safest to move over into the lee of Upernivik Island, 12 miles distant, where vessels can find good anchorage along the south coast, east of Upernivik Noes. At Naqerdloq also, 6 miles south of Igdlorssuit, the beach was found to be steep and the holding rather poor, and a motor boat could only lie there temporarily. There are no anchorages on the west coast of Ubekendt Island.

Upernivik Island: The south coast of the island has already been mentioned. Owing to the occurrence of the calm patch noted above, the small bay just north of the *fangsthus* on Upernivik Noes can be used by motor boats during south-westerly storms, but the heavy swell is distinctly uncomfortable. Temporary anchorage can be found, and a landing effected, below all the glaciers on the west coast, but the north coast gives no shelter from the strong winds out of Kangerdlugssuaq. In the strait Inukavsait, east of the island, over on the mainland side just north of Nungutakavsaq, excellent holding was found in $2\frac{1}{2}$ fathoms mud below the terminal moraine of a dead glacier. Easterly winds are not felt here. If the wind goes into the north, moor with ropes in the deep rocky cove at the south end of the beach.

Nugssuaq and the Vaigat: The boat harbour marked 1 mile north-east of Sangmerssuaraq is not to be recommended, being exposed and rocky. The statement in the *Arctic Pilot*[1] that there is no good anchoring in the Vaigat is probably intended to apply to large vessels, and even then it is scarcely accurate. On the south shore of Nugssuaq especially there are a number of places where Danish coastal schooners frequently lie, and an even greater number where motor boats can be wholly secure. The steep-sided cove at Nûssaq, though difficult to find, is particularly well worth knowing. Numerous icebergs stranded on a shallow bank outside shut out all swell; and although during easterly winds squalls rush through the ravine at the head of the cove, and strike down on the water with incredible ferocity, one can, by taking a couple of hawsers ashore, lie safely and comfortably.

One or two heavy hawsers, at least 40 fathoms in length, should always be carried. One of Professor Taylor's patent C.Q.R. anchors, kindly lent by the inventor to the Cambridge University Greenland Expedition, 1938, was tried out on the expedition's motor boat. This anchor proved extremely efficient, and the Greenlanders employed on board, once their initial distrust had been overcome, much preferred "Miki"—"the little one"—to a heavy fisherman's anchor, both on account of holding power and ease of handling. At Qutdligssat however, on the last boat journey, a large iceberg sat on "Miki," squashing the plough flat, and so rendering the anchor almost useless. A contingency of the kind, though it could scarcely have been foreseen by the inventor of the C.Q.R., has certainly to be reckoned with in the Arctic, and makes preferable the use of ordinary type anchors wherever ice can come in.

Rowing and sailing boats: The wooden boat built by Greenlanders is a simplified version of the dory. The bottom is flat, with perhaps a narrow strip of wood as keel. In place of curved timbers triangular pieces of wood are used, resting on a narrow base and nailed to the wooden straps holding the floor together. All dories are clinker built, generally of wide planking. The cross-braces (Plate 2) are removed once the thwarts are in position. The completed dory from Godthaab has narrower planking and rather finer lines than most of the North Greenland boats, all of which are designed primarily for fishing in quiet waters within a very circumscribed area, and are therefore rather unseaworthy and wholly unsuited for use with sail.

A fair number of Greenlanders own sailing boats imported from Scandi-

[1] *Arctic Pilot*, p. 86, 3rd ed., 1931.

navia. Owing to the shape of their hull, and even more to the almost universal adoption of a very attenuated sprit-sail rig, very few of these boats can work to windward. The short, sagging luff of the sprit-sail reduces its efficient area to a minimum when close-hauled on a wind.

The majority of Greenlanders are neither good oarsmen nor good sailors. When rowing, they use a short choppy stroke, frequently standing up and facing the way they are going, and they have a habit of putting the oar blade in at such an angle that the work on it is greatly reduced, and digging is inevitable. One of the crews first employed by the expedition disliked rowing so much and made so little headway even in moderate conditions that they tried whenever possible to go ashore and tow with a long rope. On at least two occasions they had to be restrained from adopting this procedure on a rocky lee shore, when towing would have been both dangerous to the boat and difficult for themselves. The failure so far of native Greenlanders to understand the principles of sailing is no doubt largely due to the lack of a seafaring tradition, and to the poor sailing qualities of the European craft to which they have been introduced. The use of rowing and sailing boats by an expedition whose work demands frequent long trips by sea cannot therefore be recommended. Suitable craft and good crews are not available, and by the time one has paid for the hire of a boat with, say, a crew of three or four, employed at the minimum rate of 25 øre per hour, the saving in money by no means makes up for the loss of time. Even a really good sailing boat would be greatly handicapped by the variability and uncertainty of winds within the district.

Greenlanders moor their boats in a very slipshod manner, using ropes which are far too light, and often with nothing more than a stone for an anchor. An interesting but not very successful attempt to combine the merits of the stone with those of the European anchor is shown in Plate 3. The four prongs of the killick are of thick wire. From one end of the iron bar which serves as shank a stone hangs loosely; to the other a somewhat heavier stone is firmly lashed.

Motor boats: All motor boats in North Greenland are fitted with simple, reliable semi-Diesel engines, but very few of them are built to sail. This is all the more surprising as in the deep water of the fjords there is no need for a shallow-draught vessel, and in the event of engine failure sail might be required to complete the voyage, or even to escape from an awkward situation such as might easily arise if icebergs were numerous to leeward, or one's crew of Greenlanders had been following their usual habit of keeping as close inshore as possible. On one occasion the engine of the *Aphrodite*, the motor boat used by the Cambridge Expedition in 1938, broke down at midnight within half a mile of Umanak, her port of destination. The *Aphrodite* is flat-bottomed, with a small sail and a lot of top hamper, and an exasperating night was spent dodging icebergs and trying to make good the last half-mile against a moderate south-east breeze. But in spite of all coaxing she steadily lost ground, and eventually when at 9.30 a.m. a motor boat came out to tow her into Umanak she was a mile to leeward of where she started sailing.

Greenlanders are very good both as engineers and as deck hands on board a motor boat, and many Danish officials give them complete charge of their

boats. The two engineers employed at different times by the expedition were almost over-conscientious, and proved capable of carrying out most emergency repairs, while all the experienced deck hands seen at work were alert, willing, and nimble. Within his own district, too, a Greenlander's knowledge of winds and weather, and of harbours, rocks, ice, and the coast-line generally, is extremely reliable, and his only fault as a motor-boat man, if it is a fault, is an occasional tendency to be over-cautious, probably because he has never seen what a good boat really can do in heavy weather.

In view of what has been said, the ideal motor boat for these waters would seem to be one built along the lines of the Norwegian pilot cutters, 30–35 feet L.O.A.; efficient both under sail and power, and so cheaper and safer than boats which rely entirely on their engines; carvel built to facilitate copper sheathing and to lessen the risk of straining the planking in ice; with an outside rudder in case of damage by ice, when a repair might have to be carried out at sea; and last but not least, with some form of protection for the propeller. It should surely be possible to design and fit some sort of cage protector which would not be much of a drag on the boat, nor greatly reduce the efficiency of a propeller.

LA MAPPEMONDE LOPO HOMEM ET L'ATLAS MILLER

Note: From time to time we have published articles on the Lopo Homem world map of 1519, the authenticity of which has excited much controversy. M. Marcel Destombes, in an article in the *Journal* for Nov. 1937, pp. 460–4, argued that the map had once formed part of the Atlas Miller of the Bibliothèque Nationale (Res. Ge. DD. 683), and that this Atlas, formerly attributed to Pedro and Jorge Reinel, was the work of Lopo Homem, and also to be dated 1519. This article gives references to the earlier literature of the controversy. M. Albert Kammerer, in an article published in the *Journal*, May 1938, pp. 450–3, accepted in the main the contentions of M. Destombes, but advanced arguments against the attribution of the Atlas Miller to Lopo Homem.

To clear up the important questions raised in the course of this controversy, a conference was held at Paris in June 1939 which accepted the authenticity of the Lopo Homem world map of 1519, and the attribution of the Atlas Miller to Homem, and further concluded that the large map (Res. Ge. AA. 640, forming with the Atlas Miller the Miller maps of the Bibliothèque Nationale) was the work of the same cartographer as the Atlas. Through the courtesy of M. Kammerer we have received a detailed report of the findings of the conference, and have been offered the honour of making these findings public. We have great pleasure in availing ourselves of this opportunity to publish the solution of this problem: much of the controversy has appeared in the pages of this *Journal*, and we recall that the first reproduction of the world map to be published appeared in the *Journal* for March 1931, with an article by Mr. Edward Heawood stating his belief that it was "a genuine work of a member of the Homem family."—ED. *G.J.*

UNE controverse qui dure depuis huit ans a été engagée autour de l'authenticité et des origines d'une mappemonde dite Lopo Homem 1519, vendue à Londres en 1930 et achetée depuis par M. Destombes. Les articles publiés à ce sujet ayant soulevé de nombreuses questions difficiles à résoudre sans la comparaison matérielle des originaux, il a semblé pratique de réunir quelques personnes qualifiées dans l'examen des cartes anciennes, pour tâcher d'arriver à des conclusions communes. C'est dans ce but que, les 2 et 3 juin 1939, se sont réunis en conférence à la section des cartes de la Bibliothèque Nationale de Paris, sous la présidence de M. de La Roncière, Conservateur des imprimés, connu pour sa compétence en matière de cartographie, assisté de M. Du Bus, Bibliothécaire de la section des cartes, et de M. Deulin, Bibliothécaire adjoint: S.E. M. Duarte Leite, ancien Président du Conseil Portugais et ancien Ambassadeur du Portugal au Brésil, réputé pour ses beaux travaux sur la cartographie portugaise ancienne; S.E. M. Albert Kammerer, Ambassadeur de France, qui a publié un certain nombre de cartes portugaises; M. Jayme Cortesão, ancien Directeur de la Bibliothèque Nationale de Lisbonne, historien spécialisé dans la découverte portugaise; M. Fontoura da Costa, ancien Ministre, spécialiste de l'histoire de la nautique portugaise; M. Le Gentil, Directeur de la Bibliothèque Portugaise de la Sorbonne et grand connaisseur d'archives; M. Destombes, capitaine au long cours, qui fait des recherches sur l'histoire de la cartographie nautique et qui a publié divers articles sur la mappemonde dont il est propriétaire; M. Guilleux La

Roerie, ancien officier de marine, spécialiste de l'archéologie navale, venu pour donner son avis sur la date des navires représentés sur les portulans.

De nombreux documents portugais du XVIème siècle avaient été mis à la disposition de cette conférence.

La discussion a commencé par un exposé de M. Destombes, qui a rappelé les conditions dans lesquelles il s'est rendu acquéreur de la carte dite Homem 1519 et les raisons pour lesquelles, d'après lui, cette mappemonde qu'il tient pour authentique, signée Lopo Homem et datée de 1519, doit être considérée comme de la même main que l'atlas dit Miller (Res. Ge. DD. 683) souvent attribué aux Reinel, atlas qui serait de Lopo Homem et de la même date que sa mappemonde, soit 1519. Pour arriver à des conclusions précises, la conférence a décidé d'étendre son examen non seulement à la mappemonde Homem, mais à tous les problèmes concernant l'atlas Miller lui-même et notamment à la question de savoir si d'autres documents n'en ont pas fait partie, ce qui vise le grand vélin Res. Ge. AA. 640, comportant sur une face la Méditerranée et sur l'autre l'ocean Atlantique.

LE GRAND VELIN (Res. Ge AA. 640). Cette carte, mesurant 62×118 cm., est composée de deux feuilles de parchemin, chacune de 410×592 mm., et de 4 bandes de 105×590 mm., qui ont été collées en haut et en bas à l'aide de joints de parchemin du côté de la carte de l'Atlantique, qui est donc le verso, tandis que le parchemin formant recto porte la carte de la Méditerranée. Des plis profonds établissent que la carte a été pliée longtemps, son format plié étant de 410×296 mm. Des piqûres d'épingle, visibles du côté de la carte de l'Atlantique, correspondent aux piqûres qui ont servi à établir l'échelle des latitudes de la carte de la Méditerranée, dont chaque degré a été percé avec une épingle. On constate sur le vélin quatre trous d'environ quatre à six mm. en forme de demi-lune, disposés sur la ligne médiane Est-Ouest symétriquement par rapport au pli central vertical. Il est évident que tous ces 4 trous ont été faits à la fois, la feuille pliée, peut-être par un poinçon, un clou ou un instrument perforant. Comparant ensuite le grand vélin, tel qu'il était replié, aux feuilles de l'atlas Miller, on constate que celles-ci sont de 418 à 420×590 à 596 mm., et portent toutes exactement les trous caractéristiques de chaque côté du pli central. Elles portent aussi sur les échelles de latitudes les mêmes piqûres (qui n'ont jusqu'ici jamais été relevées sur d'autres cartes de la même période). Quant aux graphies et à l'enluminure, on constate que l'atlas Miller est d'une écriture singulièrement voisine pour la nomenclature et que le système décoratif est manifestement le même.

Le côté du vélin portant la carte de la Méditerranée, placé à côté de la carte des Açores de l'atlas Miller, s'y raccorde parfaitement, climats compris. On trouve sur cette dernière l'origine d'un système de longitudes qui se poursuit sur la carte de la Méditerranée, dont le numérotage n'a pu se faire que les deux cartes accolées. Le bord gauche de la carte de la Méditerranée est terminé par une lisière de 1 mm. de largeur qui porte des traces d'arrachement comme d'ailleurs toutes les cartes de l'atlas, le long de leur pli central. Pour compléter l'identité parfaite de ces deux cartes (Méditerranée et Açores considérées jusqu'ici comme deux documents isolés) on constate qu'elles sont aussi les seules de cet ensemble à avoir une échelle spéciale. En effet la carte n° 1 de l'atlas (Europe Nord) est à une échelle différente et toutes les autres

cartes de l'atlas sont à la même échelle que la carte de l'Atlantique. Il ne subsiste donc aucun doute que la grande carte a bien fait partie de l'atlas. Telle est la conclusion unanime de la conférence, dont plusieurs membres expriment l'opinion que c'est l'évidence même.

Une discussion s'engage pour savoir si l'ensemble constitué par l'atlas et la grande carte émanerait d'une seule personne ou d'un atelier. Plusieurs membres font observer que la question n'a pas grande portée, étant donné que des travaux importants peuvent requérir des collaborateurs, ce qui ne diffère pas beaucoup d'un atelier ou d'une officine, et que d'ailleurs des travaux d'atelier sont effectués sous la responsabilité d'un cartographe ou chef qui en assume la paternité et doit en être considéré comme l'auteur. Cet avis est exprimé fortement par M. J. Cortesão qui signale qu'il a eu entre les mains un document des archives de Simancas prouvant que Lopo Homem ne travaillait pas seul et qu'on connaît au moins un certain Negro dans son office cartographique. Il rappelle que Fra Mauro, par example, a eu des collaborateurs, notamment Andrea Bianco.

La conclusion, à laquelle se rallient tous les membres de la conférence, est que la grande carte et les feuilles de l'atlas sont du même auteur ou tout au moins du même atelier, sous la responsabilité d'un nom unique, et qu'elles peuvent à titre égal servir de base de comparaison avec la mappemonde Homem 1519. M. D. Leite, bien qu'acceptant ces conclusions, n'estime pas que cela implique une concomitance absolue des travaux du cartographe; la grande carte pourrait être postérieure à l'atlas, mais de peu.

L'ATLAS MILLER. Bien que jusqu'ici aucune suspicion n'ait été soulevée quant à l'authenticité de l'atlas Miller, la conférence examine ce problème afin qu'aucun doute ne subsiste.

Caractères externes. On examine d'abord la question des rayures ou hachures noires qui couvrent la mer Rouge, le golfe Persique et la Caspienne, et que l'on comparera tout à l'heure à d'autres hachures relevées sur la carte Homem 1519. Cette question avait d'abord été soulevée par M. Kammerer. Il est constaté que, considérées seulement par rapport à l'atlas Miller, elles n'ont été trouvées suspectes par personne. M. Kammerer se rallie volontiers à cet avis.

Différences de graphies entre les légendes en semi-gothique et les majuscules romaines: La forme romaine des lettres qu'on trouve sur l'atlas Miller n'est pas retenue comme anachronisme ou motif de suspicion. Des lettres romaines existent dans l'Anon. Munich 1520, l'Anon. Istanbul, l'Anon. Weimar 1527 (attr. à Ribeiro). L'auteur de l'atlas a pu s'inspirer aussi des atlas imprimés de Ptolémée et leur emprunter les caractères romains.

Anomalies d'orthographe: On ne retient pas davantage comme terme de suspicion certaines anomalies d'orthographe ou erreurs grossières telles qu'OUROPA, 'equinoccialis,' 'tropicus cancri' pour 'capricorni,' ces anomalies n'ayant pas paru dépasser celles rencontrées chez plusieurs cartographes réputés; c'est ainsi que M. de La Roncière signale qu'on trouve 'France Antartique' dans le N. du Canada chez J. de Vaux, et 'pollus antarticus' là ou il faudrait 'articus' chez Homem 1554.

Caractères internes. Rapport de la lieue au degré: Dans l'atlas ce rapport diffère de l'usage courant: il est de $16^2/_3$ lieues au lieu de $17^1/_2$ et 18 qui sont

usuels, mais cette constatation n'est pas retenue comme élément de suspicion. MM. J. Cortesão et Destombes font remarquer que le rapport $16^2/_3$ au degré est déja signalé par J. de Lisboa en 1514, sans parler du livre d'Inciso imprimé en 1519.

Le déséquilibre des conceptions géographiques d'après certaines cartes du même atlas: Alors que toutes les cartes de l'atlas et la grande carte de l'Atlantique sont basées sur des relevés et renseignements réels provenant des découvertes, le 'Magnus Golfus Chinnarum' ne représente que des conceptions géographiques périmées, inspirées de Ptolémée. M. Kammerer avait soulevé le premier ce déséquilibre et en avait conclu d'abord que l'atlas est un recueil factice incorporant des cartes n'ayant pas toutes forcement des origines communs. Mais M. Kammerer a lui-même abandonné cette hypothèse et montré ensuite que certaines îles inconnues de la géographie de Ptolémée figuraient à la fois dans le 'magnus golfus' de l'atlas et dans les cartes de la Malaisie du même atlas, ce qui établit que l'auteur est le même et que la carte du 'golfus magnus,' si disparate qu'elle apparaisse par rapport aux autres, n'est pas cependant une carte simplement rajoutée à l'atlas. Le déséquilibre n'en subsiste pas moins. D'après M. J. Cortesão, il pourrait provenir de l'emploi, pour cette partie du tracé, des autres sources que l'auteur déclare, dans la légende portant son nom de la mappemonde 1519, avoir consultées, *i.e.* "collatis pluribus aliis tam vetustorumque recentiorum tabulis." M. Cortesão note aussi que la partie géographique périmée concerne uniquement des régions non encore explorées par les portugais et dont la possession était disputée, pour lesquelles, en raison d'un certain besoin de secret géographique, l'atlas a pu s'en tenir volontairement à une géographie traditionnelle.

La décoration et la miniature: l'auteur du tracé est-il le même que l'auteur de l'appareil décoratif? Et ces deux éléments constitutifs sont ils contemporains?

Il a paru que l'identité n'est pas indispensable entre l'auteur des tracés et la décoration, ce qui n'exclut pas que l'auteur soit unique. Si le travail a été fait en atelier, il y a bien pu y avoir des spécialistes pour la partie décorative. Néanmois les membres de la conférence ont reconnu qu'il existe une grande unité de conception et d'exécution dans la décoration et agencement des différentes cartes, et que l'ensemble, tant le tracé géographique que la décoration, paraissent avoir été achevés sensiblement en même temps. M. Destombes expose à cette occasion son opinion très détaillée sur l'ordre dans lequel les divers travaux de la carte ont été effectués. En ce qui concerne les riches miniatures représentant des navires portugais, M. Guilleux La Roerie expose que l'histoire de la construction des navires de cette époque est assez bien établie pour qu'on puisse dater les figurations de navires. D'après lui, les navires figurant sur l'atlas sont bien de l'époque indiquée, au plus tard 1519, et ne peuvent être que de cette époque ou de très peu antérieurs, mais non postérieurs.

Retouches: On examine ensuite si l'atlas porte des traces de retouches. Il est constaté qu'en dehors de surcharges nettement d'une autre époque, dans la péninsule Ibérique, il n'existe pas de retouches dans l'atlas Miller.

La conclusion est que l'atlas Miller y compris la grande carte de l'Atlantique, n'est pas une falsification et a tous les caractères de l'authenticité.

MAPPEMONDE DE LOPO HOMEM 1519. On passe ensuite à l'examen matériel de cette mappemonde qu'a apportée M. Destombes, examen qui porte sur les points suivants:

Authenticité. Le parchemin présente des caractères incontestables d'ancienneté. Toutefois, personne ne soulevant de problème particulier à ce sujet, il est décidé, selon l'offre qu'en fait M. Destombes, de soumettre cette carte à un examen aux rayons ultra-violets pour déceler si elle ne porte pas des grattages, surchages ou autres traces de falsifications.

Examen ultra-violet: Bien que cet examen n'ait pas été fait en conférence, il convient d'en donner immédiatement le résultat. Pour cet examen, M. Kammerer, M. Du Bus et M. Destombes se sont rendus l'après midi du 3 juin à l'Institut Pasteur, où M. de St Rat procède à cette photographie spéciale. Les épreuves en ont été tirées. Il resulte de leur examen que rien de suspect n'a pu être décelé sur les deux faces du parchemin soumis à l'expertise, parchemin qui n'est pas un palimpseste et qui n'a supporté ni remaniement ni grattage selon l'expression même de M. Du Bus.

Hachures noires dans la partie centrale des mers: Ces hachures sont-elles une cause de suspicion? Du moment que des hachures très analogues n'ont pas été retenues contre l'authenticité de l'atlas Miller et que d'ailleurs certains portulans du siècle précédent comportent aussi des rayures—quoique d'un style légèrement différent—cet argument n'est pas à retenir et M. Kammerer, qui l'avait relevé, l'abandonne.

La forme romaine des lettres, déja examinée à propos de l'atlas Miller, n'est pas davantage retenue comme un anachronisme. Certaines graphies inexactes, comme 'Isphania' ou 'Ouropa,' ne dépassent pas ce qu'on trouve dans d'autres cas, notamment chez Waldseemüller, qui écrit 'Schitia' pour 'Scithia,' et chez l'Italien Maiollo, qui signe son propre prénom 'Jhoannis.'

Les conceptions géographiques de Homem 1519 sont-elles en contradiction avec celles qui régnaient à son époque? L'originalité la plus saillante de cette conception, et qui saute aux yeux, est l'existence d'un continent austral très développé. Or cette conception était déja envisagée d'après M. Jayme Cortesão par Duarte Pacheco, dont l'ouvrage a été rédigé en 1508. On estime donc que rien dans la conception géographique ne présente de désaccord fondamental avec les documents historiques authentiques de l'époque.

Fabrication après coup: M. Du Bus demande si une pièce telle que cette mappemonde n'aurait pas pu être forgée un demi-siècle après la date indiquée par exemple pour être vendu plus facilement à Catherine de Médicis, dont les armoiries, assurément postérieures à la carte, figurent au verso sous la légende de titre. Il ne résulte pas de la discussion, assez confuse, que personne ait retenu cette supposition. M. Kammerer, sans la croire impossible matériellement, ne la trouverait acceptable que si des suspicions subsistent quant à l'authenticité de la pièce. M. Du Bus ne paraît pas tirer des conclusions précises de son observation.

Caractère flamand de la décoration: M. Du Bus pense que les anges sont d'influence nettement flamande. M. Cortesão et M. Kammerer répondent que l'influence flamande sur l'art portugais est bien connue et n'est pas un argument contre l'authenticité. M. Cortesão montre même des reproductions

de peintures de Gregorio Lopes, donc contemporaines de la jeunesse de Lopo Homem, qui manifestent des influences flamandes évidentes.

Aucun argument précis n'étant plus invoqué pour ou contre l'authenticité, les membres de la conférence expriment leur opinion individuellement. M. de La Roncière estime qu'il ne peut s'agir d'un faux; M. Duarte Leite déclare que le document à tout l'air authentique; MM. Kammerer, Cortesão, Le Gentil et Fontoura da Costa déclarent que pour eux l'authenticité est manifeste.

La mappemonde 1519 *a-t-elle fait partie de l'atlas Miller?* La confrontation des deux pièces fait paraître la similitude du format 418×595 extraordinairement approchée, vu les variations possibles dans la contraction des vélins. La même similitude est constatée dans l'état des parchemins. La mappemonde, comme les feuilles de l'atlas, présente de petites déchirures le long du pli central aux mêmes endroits des charnières. Elle porte sur le pourtour du cadre gradué à 360° des piqûres d'épingle qui traversent le parchemin, procédé employé également, on l'a vu, dans l'atlas Miller, sur les échelles de latitudes. Elle porte également deux trous en demi-lune d'environ 5 mm. de largeur aux mêmes endroits que les feuilles de l'atlas, ce qui ne saurait être accidentel. En conséquence l'avis est unanime que la mappemonde, à un moment donné, à fait partie de l'atlas Miller.

Il est reconnu aussi que l'écriture semi-gothique de la légende de titre de la mappemonde (où figure le nom de l'auteur) est la même que celle des légendes encadrées de l'atlas et que l'encre noire a bruni d'une manière très comparable.

Examen des tracés: Il est constaté que le tracé peut être considéré comme nettement influencé de la même manière dans les deux ordres de documents; pour les îles de la Sonde et le *magnus golfus* ainsi que pour la côte orientale de ce golfe descendant vers le sud. Il existe une analogie aussi pour le golfe du Bengale. Par contre il y a divergence pour la presqu'île de Malacca et ses parages et pour le tracé de la Scandinavie, quoique le dernier paraisse, malgré les divergences, relever du même procédé. En ce qui concerne le Brésil, il y a une grande ressemblance pour la partie représentée sur les deux cartes, notamment pour le grand golfe qui correspond au rio de la Plata.

Coloris : Le tracé des contours est bleu, tandis que dans Miller il est noir bordé de vert. Un examen particulier porte sur la tonalité verte générale de la mappemonde Homem. M. Destombes montre que certains verts et certains bleus de la mappemonde se retrouvent dans l'atlas Miller. Sur ce point il n'y a pas d'avis unanime.

Navires: M. Cortesão fait remarquer que, d'une façon générale, chaque navire de l'atlas a son correspondant à petite échelle sur la mappemonde, nefs correspondant aux nefs, caravelles aux caravelles, chacune avec la voilure appropriée au vent de la région indiquée. Cette correspondance, qui n'avait pas encore été remarquée, a paru établir la corrélation entre la mappemonde et l'atlas et a été retenue comme très importante. Les navires étant les mêmes que sur l'atlas Miller sont par conséquent d'un type 1510–1519, comme l'a montré M. G. La Roerie.

M. de La Roncière pose alors la question de savoir si la carte de Lopo Homem sort du même atelier que l'atlas Miller et il estime que oui. MM.

D. Leite, Cortesão, Le Gentil et Fontoura da Costa sont du même avis. M. Kammerer ne voir rien qui s'y oppose. M. de La Roncière rappelle alors que Lopo Homem avait le privilège exclusif des cartes officielles à partir de 1517 et qu'il est donc naturel, si l'on estime que les cartes sortent du même atelier, de considérer l'atlas comme étant du même auteur que la mappemonde, c'est-à-dire, de Homem avec la même date de 1519. Tel est son avis personnel. M. Kammerer pense que, bien que cette opinion soit logique et même probable à priori, il faut encore examiner la question avant de se prononcer. Il rappelle que la formule employée par L. Homem dans sa légende de la mappemonde, 'Hec est . . . tabula' s'applique d'après lui à la mappemonde seulement: de même la formule qu'on trouve sur une des cartes de l'atlas (Brésil) montre qu'elle s'applique chaque fois seulement à la carte considérée. Il ne pense donc pas que cette formule sur la mappemonde couvre ipso facto tout l'atlas. Mais dans son opinion, cet argument n'a pas une valeur négative: cela n'empêcherait pas que Homem puisse être l'auteur de toutes les cartes, bien que n'ayant mis son nom (qui n'est d'ailleurs pas une véritable signature) que sur une seule.

M. Destombes appuie l'opinion de M. de La Roncière, que si la mappemonde de 1519 est authentique, si elle fait partie de l'atlas, cet atlas doit être de Homem et de 1519, date de l'atlas. Jusqu'ici, la date de l'atlas d'après Denucé était fixée à 1516. D'autre part, M. Armando Cortesão la fixait plutôt à 1522. Le frère de ce dernier, M. Jayme Cortesão, pense que pour l'atlas rien ne s'oppose à la date de 1519. Harrisse affirme en effet que les découvertes de Alvares Fagundes sont portées sur la carte de l'Atlantique. Ces découvertes seraient matérialisées sur ladite carte de l'atlas par les mentions 'Terra Frigida,' 'omze mil virgines,' appartenant à la nomenclature dûe à Fagundes, et l'île 'Joao Esteves' (pour 'Joao Alvarez Fagundes'). M. J. Cortesão estime que ces découvertes ne sont pas celles de Fagundes parce que un cartographe comme Homem aurait porté la totalité de la nomenclature rapportée par Fagundes. M. Destombes estime que 'Terra Frigida' et 'omze mil virgines,' comme d'ailleurs 'Joao Esteves,' appartiennent à des découvertes antérieures à Fagundes et, d'après lui, João Esteves ne doit pas être confondu avec João Alvares Fagundes, dont il n'est pas encore établi que le voyage soit antérieur à 1519. Examinant la feuille du Brésil, M. D. Leite, dont c'est la grande spécialité, n'y voit rien qui s'oppose à la date de 1519. On a essayé de tirer argument de la présence du nom de Pernambouc. Mais d'après lui, un établissement portugais y a existé avant 1519 et le nom lui-même est déja consigné dans des documents antérieurs. D'autre part, les éléments géographiques positifs figurant au *golfus magnus* ont été connus au Portugal en 1515, donc antérieurement à la date supposée de l'atlas.

Attribution de l'atlas à Homem ou aux Reinel. M. Destombes a fait observer que l'attribution aux Reinel faite par Denucé était peut-être acceptable tant qu'on ne connaissait pas la mappemonde Homem 1519, mais doit être révisée aujourd'hui. Denucé, pour cette attribution, s'était basé sur la similitude de l'écriture de cet atlas avec la carte de Florence signée Reinel, et avec celle de la carte de Munich attibuée à Reinel vers 1516 par Hamy. Il n'existait à cette époque qu'une petite photographie de la carte de Florence publiée en 1894 par Casanova et les fac-similés Pregel des cartes de Munich, fac-similés actuelle-

ment à la Bibliothèque Nationale, dont les écritures ne peuvent servir de terme de comparaison puisqu'elles ne sont pas de l'auteur lui-même. D'autre part, d'après lui, l'écriture de la carte de Florence n'est pas identique à celle de l'atlas Miller. Enfin M. Ganong a montré des ressemblances entre la partie NE de la côte américaine de l'atlas Miller et deux cartes postérieures de Lopo Homem.

En fin de séance, MM. de La Roncière, Fontoura da Costa, Jayme Cortesão et Le Gentil, appuyés par M. Destombes, expriment catégoriquement l'opinion que l'atlas est de Homem. M. D. Leite exprime la même opinion qu'il a expressément confirmée, depuis, par écrit. M. Kammerer, ne voyant plus de raison pour maintenir l'attribution de l'atlas aux Reinel avec la date de 1516 (attribution et date qui n'ont jamais été qu'hypothétiques et vraisemblables), estime que l'attribution à Homem a beaucoup plus de probabilité et il se range à l'avis précité. M. Destombes déclare en terminant que M. Armando Cortesão, qu'il a vu récemment à Londres, auteur d'un ouvrage magistral sur la cartographie portugaise, lui a aussi exprimé l'opinion que l'atlas est bien de Homem et qu'il doit être daté, comme la mappemonde, de 1519.

REVIEWS

EUROPE

THE ENGLISH COUNTRYSIDE: a survey of its chief features. By various authors. With an introduction by H. J. MASSINGHAM. (The Pilgrims' Library.) *London: B. T. Batsford*, 1939. $7\frac{1}{2} \times 5$ *inches;* vi+250 *pages; illustrations.* 6*s*

MEN AND THE FIELDS. By ADRIAN BELL. *London: B. T. Batsford*, 1939. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 156 *pages; illustrations (by John Nash).* 8*s* 6*d*

These two books are well illustrated and printed, and their contents look attractive. For Batsford authors the countryside is of interest primarily for its scenic variety and for the country life which it sustains. Landscape appreciation is their main purpose, not the task of landscape interpretation which confronts the geographer. But if these authors have little that is new to tell us, they do at least write pictorially and with feeling. Freed from academic shackles, they can be as propagandist as they like on behalf of "that betrayed and neglected member of the population, the countryman," and can ignore or deplore necessary economic and technological changes in sighing for an unspoilt countryside fit for countrymen, including week-enders, to live in.

'The English countryside' is the work of ten authors whose essays depict the scenic variety of England. Taken together with the excellent photographs, this book affords a view of our countryside which should incite the holiday-maker to new adventures and the student to further inquiry. The countryside, as interpreted here, is less than the landscape as understood by geographers, for the authors have little or nothing to say about industrialization, unless a Roman slag heap lies across their path, and still less about conurbations and suburban growths, which they shun like the plague. The cult is beauty in countryside from region to region, particularly that found in "wild nature." As Mr. H. E. Bates would have it, it is the rich and prosperous who beautified our landscape, although Mr. H. J. Massingham writes suggestively of the handiwork of Hodge the husbandman as an agent of geographical change. The reader is led in turn from valleys up to downs, thence to hills, moors, lakes, and finally to our coasts. Of these many essays I prefer that entitled "Hills and wolds," by Harry Batsford, for whom "geology, like dress, does make a difference." Mr. Massingham throws down a challenge when he suggests that "the influence of geology on English scenery is now comparatively slight."

'Men and the fields' is a well-written and pleasantly readable book about the life and setting of working countrymen in different parts of England. The author, an East Anglian, seeks neither to teach nor to preach, but merely to record everyday things which he has seen or heard in the course of wanderings away from the motor roads. He does not bother much to locate his narrative, so that we are not always sure which part of the country we have reached. He has nothing sensational to record, yet with a quiet humour and a sharp eye he notes traditions and rural commonplaces in a way that holds our interest. There is no sentimentality, although the inevitable note of regret at particular changes and tendencies is often struck. The book contains some spirited sketches in colour by John Nash and a remarkable tribute to Somerset cider. W. G. E.

A NATURALIST ON RONA: essays of a biologist in isolation. By F. FRASER DARLING. *Oxford: Clarendon Press*, 1939. $9 \times 5\frac{1}{2}$ *inches;* x+138 *pages; illustrations and map.* 7*s* 6*d*

This book contains eight essays written while the author was studying the grey

Atlantic seal in the Scottish islands of Treshnish and North Rona. All are in some way connected with his two years of island life, and the third, "North Rona," is an introduction to the rest. It leaves the reader with a clear knowledge of the island's topography, weather, and human history and relics. Of the others the most successful is "Ron Mor: the Great Seal," which contains much information not accessible elsewhere, based on reliable observation. In "Sanctuaries for wild life" the author stresses several considerations likely to escape the attention of the townsman and the laboratory worker. The essays on "The display of birds," "The social life of animals," and "The mystery of antlers" combine speculation with observation: it is pleasing to see that in collecting his evidence for them the author has studied reports of previous work, and that he has discussed his hypotheses with experts. The other two essays are also well worth reading, both in themselves and as part of the whole.

The chief merit of this book however is not that it is a mine of information but that it conveys to the reader the fascination of a naturalist's life, and the high qualities of mind and spirit such a life demands. The affectionate respect with which the author habitually speaks of the animals and people among whom he lived should commend his book to many readers of varied interests. G. I. C.

A FLORA OF THE NORTH-EAST OF IRELAND. By SAMUEL ALEXANDER STEWART and THOMAS HUGHES CORRY. (Second edition.) Flowering plants, vascular cryptogams and charophytes, by ROBERT LLOYD PRAEGER. Mosses and liverworts, by WILLIAM RUTLEDGE MEGAW. *Belfast: The Quota Press*, 1938. 9×5½ *inches;* lx+472 *pages; maps.* 10*s* 6*d*

The area included in this work comprises Down, Antrim, and Londonderry. Thanks to the early pioneer work of Templeton, Moore, and Stewart, and especially to the more recent researches of Dr. Lloyd Praeger, these counties are among the best-known botanically in the British Isles. Although they do not possess the outstanding fascination of the western and south-western parts of Eire, they nevertheless show a number of features of interest to botanists. It is here that the Scottish element of the Irish flora is best represented, while Lough Neagh, the Mourne mountains, and the large sand-dune area at Magilligan are all good hunting grounds.

It is fifty years since the first edition of this Flora was published by the Belfast Naturalists' Field Club, and the Club is to be congratulated on the new edition by Dr. Lloyd Praeger and Mr. W. R. Megaw. In Part I, which deals with flowering plants and vascular cryptogams, the list of species is preceded by an historical introduction and sections on the geology and topography in relation to the flora, while in Part II (mosses and liverworts) a brief survey is given of previous work on these groups. Under each species the habitat, status, and detailed distribution in the area are given. The frequency with which Dr. Praeger's own name occurs in recent years shows how much our modern knowledge of the flora, especially of critical groups, is due to his researches. The nomenclature is, on the whole, correct and up to date, but the generic concepts chosen would not always meet with the approval of specialists, notably in the grasses.

Local floras are often regarded merely as aids to the amateur flower-hunter in the pursuit of his hobby. That they can be of real scientific value if written by a botanist with a knowledge of critical forms and an appreciation of the facts and theories of geographical distribution is amply illustrated by the present volume. The book is well produced and a useful topographical index is included.

J. S. L. G.

DANISH DELIGHT. By MONICA REDLICH. *London: Duckworth*, 1939. 9×5½ *inches; 272 pages; illustrations.* 8*s* 6*d*

In spite of her complaint that the Danes are "too sensible," and that life in Denmark "often seems too good to be true, and far too good to be exciting," Miss Redlich has written a charming and intelligent book about her adopted country, and one which should make many of us who are compelled to remain citizens of what she calls this "bad old, entertaining, unregenerate" country a trifle envious.

The book is written as a journal of her daily life as a Danish housewife, but within this framework Miss Redlich manages to tell us of many things beside domestic matters. 'Danish delight' is not one of those encyclopaedic books about a foreign country especially designed to impress the reader with the erudition of the author. There are facts in Miss Redlich's book, but they do not flow in a never-ending stream. She has absorbed them as she has other experiences, and is therefore able to present them to her readers in an entertaining and acceptable form. She tells us of the Denmark she has herself seen and is beginning to know, and while she does not scorn to describe for us places and scenes such as the Glyptotek, Tivoli, the Little Mermaid, the Fishwives of Gammelstrand, known to all foreign visitors to Copenhagen, she is able through her more intimate knowledge to include a number of less familiar experiences.

In her judgment of the Danes Miss Redlich is perhaps too ready to draw conclusions from a limited circle of acquaintances, who seem to differ greatly in occupation and outlook from her artistic and literary London friends. Nevertheless her book is one which will give much pleasure to both Danish and English readers. M. S.

TEN YEARS UNDER THE EARTH. By NORBERT CASTERET. Translated and edited by BARROWS MUSSEY. *London: J. M. Dent and Sons*, 1939. 8½×5½ *inches;* xvi+240 *pages; illustrations and location map.* 12*s* 6*d*

The fact that this book is in English—an effective translation and combination of M. Casteret's two successive works 'Dix ans sous terre' and 'Au fond des gouffres'—is an interesting indication of the link between underground exploration in this country and in France. Where the Tarn and Jonte meet at the Millau approach to the Gorges du Tarn there is a monument to M. E. A. Martel, the pioneer French speleologist, and his colleague, Armand: this memorial is a French tribute to M. Martel's work. In 1895 M. Martel visited Ireland and England and his first descent of Britain's best-known pothole, Gaping Gill, inaugurated an interest in speleology as applied to the exploration of caves and potholes.

Appropriately, too, there is an introduction by M. Martel, who refers to M. Casteret's work as "real geography," alluding particularly to attempts to trace the courses of underground rivers, especially in relation to political frontiers. The translator has done his work well, capturing the spirit of underground adventure which runs through the varied chapters.

Perhaps the most interesting feature of the book is M. Casteret's account of his discovery of the further reaches of the Grotte de Montespan in the Garonne Pyrenees. Here, in 1922, M. Casteret dived through syphons—"sump diving" is now the phrase used in the Mendips, where this form of advancing exploration is practised—and discovered rock engravings and mud statues of the Magdelenian era. Following this exciting introduction, the author goes on to tell of other archaeological research, and he discusses some of the unsolved problems of prehistoric art. While his account is chiefly of cave drawings in the Pyrenees,

his conclusions are applicable in many cases to the better-known cave paintings and carvings of the tourist Périgord.

The story of his siege of the deepest abyss in France, the Gouffre Martel, on the flank of the Pyramid de Serre in Ariège, is an exciting one. The true source of the Garonne, a problem solved by hydrological exploration, is an effective climax to some twenty chapters. Those who know the complicated terrain of the Maladetta will appreciate the author's difficulties; those who do not have the assistance of a good map and they will find the account of absorbing interest. In contrast, the British problems of underground waters may be of trifling importance; British speleologists would not need to throw 125 lb. of costly fluorescein into a point of engulfment to determine the source of a river, as was done with the Garonne. The book is well illustrated with line drawings and some very good plates. The latter are of considerable value; they show the equipment of the French potholer to be far in advance of his English colleague. As to the methods of exploration, there is perhaps a disquieting insistence on single-line descents, and the French wire ladder looks less safe for long-distance work than the British manilla rope ladder. But tribute must be paid to M. Casteret's work (he has explored well over five hundred caves and potholes) and equally also to the quality of the written material and to the vivid way in which he pens pictures of scenes underground.

The index will be appreciated and the two maps are adequate. Sections of some of the potholes described would have been welcome. Again, as befitting a book with an obvious popular appeal, speleological problems are only lightly sketched and one regrets that it has not been possible to discuss some of the more obvious questions. Speleology in Britain is less advanced than in France, and it would have been of advantage if M. Casteret could have given his views, for instance, on the formation of caverns and the reason, less important, for the curious concretions best seen at the Grotte de Grand Roc at Les Eyzies, which are equally disconcerting when viewed in the depths of Gaping Gill. A. M.

SOUTH-EASTERN EUROPE: a political and economic survey. Prepared by the Information Department of the Royal Institute of International Affairs. *London: Oxford University Press, for R.I.I.A., June* 1939 (*second edition*). 9×6 *inches;* xvi+204 *pages; maps.* 5*s*

As the sub-title implies, this compilation is designed to meet the needs of economists and students of politics; and here it is hardly necessary to do more than broadly indicate the contents. About a quarter is devoted to a general review of diplomatic history since 1919; and there follow two series of parallel chapters on internal politics and economics of each of the seven countries included in the survey (Hungary has been added to the conventional Balkans). There is a brief summary, which demonstrates that the effects of the German trade drive have been exaggerated, the chief results having been accomplished at the expense of Italy. Two editions have already appeared; and the second was revised down to the end of last May. J. H. G. L.

ASIA

SYRIA AS IT IS. By Helen Cameron Gordon (Lady Russell). *London: Methuen and Co.,* 1939. 9×5½ *inches;* viii+212 *pages; illustrations and sketch-maps.* 10*s* 6*d*

This attractive and well-illustrated volume is misnamed: any one seeking for information on the changing political and economical situation "as it is" in Syria will be disappointed. The breaking up of the land of Syria into two

Republics and three "governments" (including the new Turkish Hatay), not to mention Palestine and Transjordan, receives little but passing reference. In this respect the chapter entitled "Disunited Syria" is especially disappointing. There are somewhat sketchy descriptions of several places—Damas, Hama, Homs, Alep, and "tragic" Antioche. Jubeil is described as the "oldest city in the world," once surrounded by "the most powerful ramparts the world has ever seen." The description of the wonders of the ruins of Roman Baalbeck is spoilt by fanciful speculations regarding a supposed pre-Roman temple. There are other romances drawn from Arabic sources. There are many all too brief references to the treasures of ancient architecture which abound in this region. A tourist who has been—or intends to go—to Syria will here find much to stimulate his interest. There are some curious mistakes. On p. 56 it is stated that as a result of the capture of Jerusalem in 1187 "Richard Coeur de lion sailed for Europe *via* Cyprus," whereas it was this very event that drew him *to* Palestine in 1189. On p. 83 there is the suggestion that in the eighth century A.D. "streams of molten lava" flowed from the extinct craters in the Jebel Druze "and made it a country of black basalt stones of eccentric shapes and sizes." There is no evidence that there has been volcanic activity in these lands within historic times. It is somewhat irritating in a book written in English and for English readers to find so many names and words in an unfamiliar form, *e.g.* Baudoin King of Jerusalem instead of the usual Baldwin, Tcherkesses instead of Circassians. Ech-Cham is wrongly translated "a mole" (p. 50), and was never the "early Arabic name" (p. 114) for Damas. The transliteration of Arabic words is faulty in many places: *Zaghareeb* (p. 98 and elsewhere) should be *Zaghareed*. Many supposed Arabic words should not be italicized, as they are impossible Arabic plurals (such as Souks, Sheekhs, narghilies, nourias, khalouats, etc.). Dumdums (p. 59) and tom-toms are not Arabic words for drums. E. W. G. M.

TIBETAN ADVENTURE: travels through Afghanistan, India, and Tibet. By HERBERT TICHY. Translated from the German by IAN F. D. MORROW and L. M. SIEVEKING. *London: Faber and Faber*, 1938. 9×5½ *inches;* 262 *pages; illustrations and maps.* 12*s* 6*d*

In his introduction the author says frankly that his book is not intended to be scientific or learned; but he continues (in the German edition), in the same sentence, to assert that his story is not even one of adventure, since "keiner meiner Freunde wird ermordet, ja nicht einmal von einem richtigen Raubüberfall kann ich dir erzählen." Herr Tichy possibly wrote this with his tongue in his cheek, for surely it is not an essential of adventure that it be connected with crime or sudden death; in any event it is not only full of adventures, but delightfully easy reading, even if one is unable to agree with some of the things the author said or did.

Aged twenty-three, Herr Tichy left Vienna for India, with the idea of combining geology with journalism. Almost as soon as he reached Bombay however he threw over this plan, and decided to devote his time to studying some of the Asiatic races, and trying to enter into their thoughts and aspirations. This ideal necessitated living with them, as far as possible as one of their own kind; and, not unnaturally, the book is very largely concerned with the people he met and travelled with, to the exclusion of much detail about the journeys themselves. From Bombay he went through Delhi and Peshawar to Afghanistan; thence to Kashmir; to Burma; and so into Assam *via* the Naga Hills and Manipur. From Assam he returned to Delhi, and went up to Almora, where he disguised himself as a low-caste Hindu and (with a young Indian student and Kitar, one of

the Darjeeling porters who later died on Nanga Parbat) joined a pilgrimage to Mount Kailas, in southern Tibet. He finally left India by motor bicycle through Afghanistan and Persia.

It is a serious blot on an enterprising journey that the author tried to pass himself off on one occasion, unsuccessfully, as a Brahmin; and on another, with more success, as a descendant of Muhammad; in each case to induce the peasants to give him refreshment. None the less the book is well written and full of interest. The photographs are mainly good, and the two maps are adequate. R. K.

ORIENTAL ASSEMBLY. By T. E. LAWRENCE. Edited by A. W. LAWRENCE. *London: Williams and Norgate*, 1939. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xii+292 *pages; illustrations and route-map.* 10*s* 6*d*

This is a collection of the miscellaneous writings of the late T. E. Lawrence. It comprises a "Diary of a journey across the Euphrates" with nineteen photographs, two articles published in 1920 dealing respectively with the Arab revolt and political conditions in the Middle East, and three glosses on the 'Seven Pillars of Wisdom' in the shape of a suppressed introductory chapter, a note on Eric Kennington's portraits, and over a hundred war photographs. The attention of the geographer need be directed only to the first and the last.

The diary covers a period of one month, from 12 July to 12 August 1911, and deals chiefly with the exploration of the castles at Urfa, Harran, Birijik, and Rum Qal'at. Apart from the notes of varying fullness on the ruins it contains little beyond the bare record of the frugal hospitality offered each night by the villagers, Arab, Turk, or Kurd, with whom he stayed, and a few personal details. The height of summer is an exacting season in those latitudes for a three weeks' tour on foot. The powers of physical endurance that were to stand him in such good stead a few years later carried him through, but before he had finished the examination of his last castle he was seriously ill, with blistered feet, dysentery, and fever.

The war photographs are of unequal quality, but in so far as they will assist the reader of the 'Seven Pillars' to visualize the type of country in which Lawrence's exploits were set their publication is to be welcomed. C. J. E.

AFRICA

BY BUS TO THE SAHARA. By GORDON WEST. *London: The Travel Book Club*, 1939. $9 \times 5\frac{1}{2}$ *inches;* 234 *pages; illustrations and route-map* (*by Mary Gordon West*). 10*s* 6*d*

This is a well-written travel book which records the adventures and impressions of the author and his wife, on a journey through Morocco which lasted several weeks. The reader should not assume from the title however that they were travellers by bus through indigence. They travelled by the rather uncomfortable Moroccan buses between Rabat and Fez, and in other parts where there was no train available, and by this means reached the fringes of the Sahara, passing through the wild and only recently pacified south-east of Morocco on the way. They had many interesting encounters, and the author has succeeded in producing a very attractive light descriptive narrative, which, illustrated by a number of pleasing reproductions of sketches made by his wife, evokes a correct impression of the new Morocco, and entertains considerably in doing so. W. Fg.

AFRIKA—HEFT. (Geologische Rundschau. Band 28. Heft 3/4.) *Stuttgart: Ferdinand Enke*, 1937. 9×6 *inches;* 161–384 *pages; illustrations and maps.* *M*.24

This well-illustrated book is a collective account of various geological problems

written by German experts and dealing with African territories south of the equator, mainly the former German colonies South-West and East Africa.

H. Cloos gives a fascinating description of general geological and morphological observations in South-West Africa; G. Knetsch explains the origin and prospecting features of the diamond deposits and the geology of the southern Luederitz area. In addition there are contributions on South-West African geology (Naukluft range), on the goldfields of Ondundu, on the geology of south-west Angola, and on the geomorphology of West Griqualand. H. Cloos discusses recent achievements in geological mapping of the Ventersdorp–Klerksdorp area (Transvaal), and E. Ackermann describes the various prospecting methods during the copper boom in Northern Rhodesia. H. Schneiderhoehn makes some further attempts to prove the syngenetic-sedimentary origin of the Northern Rhodesian and Katanga copper deposits, a theory which so far has not been accepted by any of the British and American specialists familiar with the geological and mining conditions of these areas. There are also discussions of the tectonical, stratigraphical, and general geological problems of Tanganyika Territory. Finally H. Cloos draws his own conclusions as regards the fundamental structure of the African continent and its relationship to the surrounding ocean depressions. Though he recognizes outspoken similarities, he does not accept Wegener's theory of continental drift.

H. P. T. H.

CELLULOID SAFARI: filming big game from Cape to Cairo. By STIRLING GILLESPIE. *London: Blackie and Son*, 1939. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* x+278 *pages; illustrations (photographs by J. Blake Dalrymple and the author) and route-map.* 12*s* 6*d*

IN THE SAND FOREST: lion-hunting with the Maquengo Bushmen. By Captain ARNOLD WIENHOLT. *London: John Long*, 1939. $9 \times 5\frac{1}{2}$ *inches;* 208 *pages; illustrations and sketch-map.* 10*s* 6*d*

Mr. Gillespie gives a very readable account of a motor journey from Cape Town to Cairo. The book is interestingly written and conveys a good idea of the many territories visited. Though criticisms might be made of certain inaccurate descriptions of native customs, and the use of local languages, these are only incidental to the general story. The author and his companion managed to have plenty of adventure without seeking dangerous situations, and the fact that they made their entire journey without gun or rifle is representative of the new spirit of hunting that has arisen with the use of the ciné camera. The book will hold the interest of the casual reader, and should certainly not be missed by any one who may contemplate visiting any of the countries through which they passed.

Captain Wienholt has marched far with the Maquengo Bushmen, and in this book he shows us something of their nature. His sole purpose of travelling in Angola was to hunt lion; it is not therefore surprising that there is little of geographical interest and indeed no pretence at any form of scientific observation. The book is readable and leads gently on from episode to episode, giving the reader a picture of a hunter's travels and troubles in that part of Africa.

V. E. F.

NORTH AMERICA

LA PÉNÉTRATION DU CONTINENT AMÉRICAIN PAR LES CANADIENS français, 1763–1846. By BENOÎT BROUILLETTE. *Montréal: Granger Frères*, 1939. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches;* 242 *pages; illustrations and maps.* $1.00

This is the first of a proposed series, supported by the French-Canadian Association for the Advancement of Science, and its primary appeal will be to

French Canadians, though of considerable interest to readers outside this circle. Since the century opened there has been quite a flood of literature on the early fur trade and other adventure in North America, and the present work does not add greatly to existing knowledge; but it gives a new emphasis to a special side of the subject, and on the basis of what has already appeared, mostly written in English, brings out clearly the outstanding rôle of the French *voyageurs*, *coureurs de bois*, and others in opening up new country during the period 1763–1846, the first date being chosen as that in which sovereignty in Canada passed from France to England.

The subject-matter is divided under the headings of Traders, Explorers, and Missionaries, each of which categories played its special part in the period dealt with, when the early importance of the missionary in actual exploration had somewhat declined. It is the second division with which we are more specially concerned here, but the general picture of the important work of the *voyageurs* is of distinct interest. Even after the conquest they remained an indispensable resource of the English trading companies and firms, and many striking testimonials to their sterling qualities are culled from the narratives of their employers. Many individual names are recorded, some being traders on their own account and well worthy of remembrance. An interesting general point is the relatively small local disturbance caused by the change of sovereignty, which actually remained unknown for several years in some districts. The contrast between the North-West and Hudson's Bay Companies in the early employment of *voyageurs* is also well brought out.

In the exploration section the work of well-known men like Mackenzie, Fraser, Thompson, and even Lewis and Clark, all of whom relied largely on French-Canadian subordinates, comes under review, but there is greater novelty in the record of independent work by men of French origin, only lately rescued from oblivion by research in Canada and the United States, with the results of which the author shows himself thoroughly familiar. Special mention may be made of J. B. Perrault, a man of some culture, whose journals, first printed in 1909–10, cover an extensive range of travel in Minnesota and Wisconsin; and of P. A. Tabeau, whose narrative of a trading journey on the Missouri in 1803–05, at present in MS. only, gives a vivid picture of the country and tribes visited.

The extremely careful bibliographical notes, and the unusually complete index, are valuable features of the book, one's only criticism of the former being that as they appear at the end of the several chapters, often necessitating a reference back from a later to an earlier list, the original entry is not always easy to find. Some help is given by mention of the running number in the earlier list, and the chapter to which this belongs, but there are no page headings to guide one to the chapters themselves. There is a general map showing travellers' routes and illustrations depicting the life of the *voyageurs*. E. H.

VIRGINIA: the old dominion. By MATTHEW PAGE ANDREWS. *New York: Doubleday, Doran and Co.*, 1937. $9\frac{1}{2} \times 6$ *inches;* xviii + 664 *pages; illustrations and maps.* $6.00

Much as has been written on various aspects of Virginian history—political, social, and economic—on some of which even fiction has thrown a useful light. It appears that till now no one work, in the compass of a single volume, has drawn together the threads of such history on the basis of modern research, and it is the aim of Dr. Andrews's book to supply the want. He is no mere compiler, but has spent several years in painstaking research in unpublished or not easily accessible sources. With so much material to draw upon the task of condensa-

tion has not been easy, and the author explains that with a view to presenting a readable narrative it has been necessary to relegate the heavier part of his results to notes and bibliographical references, which are supplied in full abundance. The main outlines of the story have often been sketched before, but much new material has been embodied, often throwing new light on obscure points, so that the book will no doubt rank as the standard authority on its subject. It will appeal to all Americans, even those having no personal association with Virginia, but to others it will probably serve rather as a work of reference than one to be read consecutively, for in spite of the condensation the story is told in more detail than may altogether appeal to the general reader.

Dr. Andrews writes as an historian, making little or no attempt to trace such influence as may have been exercised by geographical factors, and a detailed review is not called for here. The geographical background is taken more or less for granted, and we have found but a couple of casual references to the Blue Ridge as long marking the limits of extension inland. Survey and exploration are referred to in very general terms, even Washington's work in this field being but cursorily dealt with. One would have liked to learn more of the pioneer journey of John Lederer, whose narrative is one of the scarcest of American travels. But in a work covering so wide a field much space could hardly be given to such special themes, and on many subjects of more general interest—the progress of settlement, the development of economic resources, social life, religion, education, and even mechanical inventions like McCormick's harvester —the reader will learn much. The political and military sides of the story are of course kept well in view throughout.

There are some well-chosen illustrations, including one or two reproductions of early maps, but we miss any help in the way of a clearly drawn modern map. The bibliographical references already spoken of will be perhaps the most valuable feature in the eyes of serious students. E. H.

CENTRAL AND SOUTH AMERICA

THE POCKET GUIDE TO THE WEST INDIES, BRITISH GUIANA, British Honduras, Bermuda, the Spanish Main, Surinam, and the Panama Canal. By Sir ALGERNON ASPINALL. New and revised edition. [Ninth Issue.] *London: Methuen*, 1939. 7×4½ *inches;* xvi+526 *pages; illustrations and maps.* 10*s* 6*d*

The author, for many years the Secretary of the West India Committee and a prolific writer on the West Indies, has a unique acquaintance with that region. Geographically the term West Indies connotes all the islands within the Caribbean Sea, but several mainland countries—British Guiana, British Honduras, etc.—as well as the island of Bermuda, are now included for administrative purposes within the area known as the West Indies. All these islands and mainland countries—British, French, American, Dutch, and the Black, the Dominican, and the Cuban Republics—are fully described, and their industries, climate, history, constitution, religion, and sights are delineated; while interesting chapters are given on the Spanish Main and Panama with its canal.

This book contains everything the tourist needs to know, while for business men with interests in the West Indies, and for the geographer and general reader, there is much that is both informing and interesting. It is profusely illustrated and there are numerous maps and town plans. The descriptive portions are printed in a good clear type, while in other sections smaller print is used, as if to suggest to the reader what he may pass over if he is not interested.

The book is remarkably complete; but one statement needs amplifying.

The author says that parasites and epiphytes are seen growing on the trees. From this rather bald statement no reader could imagine the reality—the spectacle of trees covered with the finest orchids, ferns, begonias, cactuses, arums, and other superb blooms, besides flowering shrubs and small trees, and festooned with brilliant creepers. And these tropical wonders are to be seen in forest and field, in park and private garden, and even by the roadside. Indeed, it is worth while going to the West Indies if only to see a splendid pageant of natural beauty. G. M.

CARTOGRAPHY

THE GREAT SOVIET ATLAS OF THE WORLD. Vol. I. Published by decree of 17 December 1933 of the Central Executive Committee and of the Council of National Commissars of the U.S.S.R. *Moscow: Scientific Publishing Institute for the Great Soviet Atlas of the World*, 1937. 21 × 14½ *inches; 119 plates*

The new Russian general Atlas is to be published in three large volumes of which the first forms the subject of this review. It appears that the complete Atlas will be the most comprehensive of its type that has so far appeared in any language. It is therefore the more unfortunate that the editors have not followed the example of other Slavonic countries and given the map titles and keys in French, German, or English as well as in Russian. In general it may be said of this volume that the information is up to date and that the standard of production is high: with excellent colour-printing by the offset process in the style of the Swedish Vārldsatlas. Comparison of the contents with the older atlases is hardly relevant, for those were mainly topographical, while the Russian Atlas embraces the whole range of physical and economic maps besides some that are purely historical. Plates are devoted, for example, to early cartography, to geographical discovery, to emigration movements, to political changes, and to details of the chief army movements and battles of the Great War. There are also some demographic maps, but a majority of the eighty-three plates devoted to the world as a whole deal with physical, vegetational, and economic distributions. Among these the reader will probably pause longest upon the gravimetric map, the general soil map, the precipitation map embracing the oceans as well as the lands, and the map of climatic types. The economic maps, based on data down to 1936, deal with the production and movement of commodities in conventional fashion.

The Russian section occupies the remainder of the volume, the whole of the U.S.S.R. being shown on a single sheet or plate in the general maps, but supplemented by larger scale maps of Russia in Europe. Here the geological, glaciological, geomorphological, and soil maps call for particular commendation, as also a special plate showing the mineral base in the Central Urals, the solid geology and mineral distributions being mapped side by side. The general vegetation maps, too, contain much that is new or unfamiliar, and in spite of the differentiation of some forty types, overprinted in some cases with symbols denoting predominate species, the general picture of very definite zoning is not lost, this result being achieved by the very well thought out colour scheme.

On the twenty-seven plates devoted to economic matters the volume of production of particular groups of commodities is indicated by an ingenious system of parti-coloured rings drawn to scale. Movements from producing to consuming areas are in some cases illustrated, as for example between Magnitogorsk, Kuznetz, and Turkistan. Dot maps are limited to eight or nine plates showing crop and stock distributions, and this often-abused cartographic

device is here very judiciously employed. Maps of particular interest are the series showing the progress of collectivization and that of communications by air. The rapid progress made in both directions since 1928 is remarkable, but the fact is not concealed that in Siberia especially enormous tasks still await completion.

It remains to be seen whether the indubitably high standard of this first volume can be maintained in those devoted to foreign countries. The policy of isolation which, with but few exceptions, confines scientists of all ages within the Soviet boundaries is not one likely to be conducive to the sound geographical judgment essential in dealing with masses of literary and statistical material.

E. G. R. T.

PHOTOGRAMMETRIE. By RICHARD FINSTERWALDER. *Berlin: Walter de Gruyter and Co.*, 1939. $9\frac{1}{2} \times 6$ *inches; 238 pages; illustrations. M.14*

There are already more than a few books about photogrammetry written in German. The treatise by Baeschlin and Zeller is still a new book, and von Gruber's collected essays will be essential to serious students for many years to come. But this book of Finsterwalder's does not merely easily find a place amongst the giants; it fills a gap of which many of us had been very aware for some time.

The merits of the book are inevitably of a technical nature. Perhaps they can be best summarized by saying that it is thorough precisely at those awkward points in practice and theory which give difficulty to student or practitioner; and that it summarizes ably the elementary material with which some text-book writers have filled out their pages. The consideration of errors is expressed without losing view of the practical applications; and naturally the author has been able to include some treatment of the cases of ambiguous resection in space as they effect procedure in aerial triangulation. Nevertheless terrestrial photogrammetry still precedes air survey in the order of contents; and it is a little surprising that the author excludes the oblique photograph from the air altogether from consideration. A final, and most welcome, merit is that nowhere in the book is there so much as a trace of that rivalry between firms of instrument makers which has so coloured much of the existing Continental literature on photogrammetry.

M. A. S.

FORMELN UND TABELLEN ZUR BERECHNUNG DER NIVELlitischen Refraktion. By T. J. KUKKAMÄKI. *Helsinki: Finnish Geodetic Institute* (No. 27), 1939. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches; 18 pages*

The theory on which these formulae and tables are based was described in a previous work by the same author, reviewed in the *Journal* for February 1939. The general conclusion was that in precise levelling refraction is proportional (1) to the difference of temperature at the upper and lower readings on the staff; (2) to the square of the length of the shot; and (3) in some measure to the difference of height. Greatest at some time around midday, it falls to zero about an hour after sunrise and an hour before sunset. The midday value is roughly twice as great as the night value, and is of opposite sign. Consequently during the day measured differences of height are too small, while at night and in the early morning and late evening they are too great. The present tables have been computed in order to implement the theory.

The tables are framed on the supposition that the height of the level is 150 centimetres, but a short correcting Table 3 is given to allow of variations from that height. The working formula is

$$\rho = 10^5 \gamma \Sigma (s/50)^2 \theta D,$$

where s is the length of the shot in metres, D is the difference in height of the

readings on the staves in half-centimetres, θ is in degrees centigrade the difference between the temperatures at heights above ground of 50 and 250 centimetres, the staff being regarded as commonly 3 metres in length; while γ is a factor depending mainly on the temperature gradient. The sign Σ is merely the summation of all tabular figures between bench marks, it being found that in general the mean value of γ may be taken for a stretch of levelling of this length. The last factor after Σ is computed with the aid of Table 1; this table of double entry shows the value of $(s/50)^2\theta$ for measures of θ varying by 0·2° C. up to 3° C. and values of s varying from 10 to 60 metres. Table 3 sets out the value of γ for each hour of the day and each month of the year and for latitudes varying by 5° from 30° to 50° and thence by 2° to 64°. This factor γ is based on observations made by A. C. Best in southern England prior to 1935 and also on the theory of the temperature gradient which was discussed in the previous review; it is noted that the value of the "period constant" c there mentioned has been verified, in apparently great measure, by M. Franssila in Finland. The time is local time throughout, but the extrapolation through such a range of latitude would seem to call for independent verification in the lower latitudes tabulated. Formulae are given for excessive departures from the tabular normals. G. T. M.

ECONOMIC AND HISTORICAL GEOGRAPHY

THE STUDY OF SOCIETY: methods and problems. Edited by F. C. BARTLETT, M. GINSBERG, E. J. LINDGREN, and R. H. THOULESS. *London: Kegan Paul, Trench, Trubner and Co.*, 1939. 7×5 *inches;* xii+498 *pages; diagrams.* 10*s* 6*d*

This symposium consists of contributions from members of a group of psychologists, anthropologists, and sociologists working in close cooperation. It provides an admirable survey of contemporary methods and problems, condensed into nineteen essays with comprehensive bibliographies. This enables the reader both to obtain a conspectus of modern social and psychological research and to follow up a variety of profitable and stimulating leads. The editors, and particularly Dr. Lindgren, are to be thanked for their achievement and for their promise of further studies along the same line.

Though most of the essays are concerned with clearly formulated and definite problems of human adjustment, the methods by which they may be attacked and some indication of the general conclusions reached, they lapse from time to time into discussions of theories entirely irrelevant to concrete investigations. This is particularly marked in the concluding essay, and even Dr. Lindgren's scholarly review of the study of folk-lore includes much that emerges from dilettante or antiquarian interest rather than from active scientific research. She is more concerned with the various ways in which folk-lore has been treated than with the problem of its cultural significance, and for this reason she does not do justice to Malinowski's treatment of the subject. The knowledge of the cultural context which she stresses is merely a preliminary to the real task of the scientific student of folk-lore, namely the precise delineation of the rôle of belief in determining human action in social, religious, and everyday life. In its relation to social behaviour as a whole lies the real significance of folk-lore. This she neglects in favour of insistence on minute observations of behaviour during narration, observations which form but a small proportion of those necessary for the solution of the major cultural problem.

Probably the most valuable essays are Dr. J. T. MacCurdy's discussion of "The relation of psychopathology to social psychology" and Dr. Audrey

Richards's excellent review of modern field methods in social anthropology. Dr. S. F. Nadel's treatment of intelligence tests in the anthropological field is the best example of the synthesis of disciplines which this book foreshadows. He stresses the limitations as well as the potentialities of this approach, the need for a highly critical evaluation of the results of tests applied to primitive peoples, and the danger of such results being used as a social or political weapon on the basis of wholly unjustified inferences concerning "racial" variations. R. P.

HERRN HOFRAT UNIVERSITÄTSPROFESSOR DR. EUGEN OBERhummer . . . zu seinem 80. Geburtstage. [Special unnumbered issue of *Mitt. Geogr. Ges. Wien*, edited by HERMANN LEITER, containing 16 papers by various authors.] *Wien*, 1939. 9½×6½ *inches; 164 pages; illustrations and maps*

The majority, but not all, of these articles deal with the country round Vienna, and include studies of towns in Carniola and Moravia, the geography of Austria in prehistoric times, the new frontiers, and the Danube. The two women contributors alone impart what flavour of originality is perceptible. Maria Leiter chooses the subject of "The hat in world trade" as her theme, and treats it, after the manner of a section in Andree's *Geographie des Welthandels*, in a solemnly systematic and therefore rather entertaining fashion. We learn that Great Britain is the world's leading exporter of hats, and that our staple is the bowler—"Eine Eigenart der englischen Hutererzeugung ist der meist schwarze, steife Hut, *Bowler*, der auch in anderen Ländern von zählungskräftigen Käufern begehrt wird." Johanna Schmidt has, under the title of "Volk der Mitte," compiled a most instructive series of excerpts from geographical writings extending from earliest down to modern times, all by authors who were conscious of a real or fancied pre-eminence of their country in the world, and wished to explain this in terms of geographical advantages. Thus both Aristotle and Pliny believed that their respective homelands could be regarded as the centre of all things: the former because of its intermediate position between the hearty, free, and savage peoples of northern Europe, and the cultivated but unfree peoples of Asia; the latter claiming that Rome was predestined to rule the world because of its mild temperate climate and its middle position between the lusty, rude barbarians of the north and the intelligent but unwarlike southerners. After a series of brief references to Petrarch, to Juan Huarte (in regard to sixteenth-century Spain), to Bodin, and to the Chinese, all of whom produced very good reasons to show how geographical conditions justified their claim to be the Middle People, we turn to German writers. Awareness of being fortunately located at the focus of the world seems first to have been perceived in Nürnberg at the apogee of its prosperity: according to the Humanists and Münster it was umbilically situated in the middle of Germany and therefore in the middle of Europe. It was not long before it was discovered that to Germany could be ascribed exclusive advantages in respect of climate as well: Bebel wrote that the human race (in Germany) possessed greater vitality because of the strong contrast between the seasons. In this he agreed with Montesquieu. Von Hertzberg, Minister of Frederick the Great, thought that the Prussian race was indebted for its martial qualities to the ruder northern climate of its homeland. But other German writers have been guilty, by a certain confusion of thought, of attributing to Germany the same geographical advantages that Greek and Roman writers claimed for their respective countries. For Clüver, the Germans were fortunate because their climate was neither so cold as that of Scandinavia, nor so hot as that of the Mediterranean. Leibnitz, Kant, and Herder all restated the same view. In short, as the centre of gravity in Europe shifted north of the Alps, the doctrine that certain lands possessed unique advantages in virtue of

their temperate climate was also displaced, and was reiterated by numerous writers without the slightest hesitation or sense of inconsistency. The whole of the Mediterranean now became too hot to allow the race to reach its highest levels; but central Europe, instead of forming part of the cold repellent north, became the ideal home for the human race. J. H. G. L.

THE BACKGROUND OF ART. By D. TALBOT RICE. (Discussion books. No. 64.) *London: Thomas Nelson and Sons*, 1939. $7\frac{1}{2} \times 4\frac{1}{2}$ *inches;* 172 (*inc.* xii) *pages.* 2*s*

Only one chapter out of nine deals with appreciation of art: Professor Rice is primarily concerned with its "deeper associated interest" and warns his readers against undue preoccupation with the dates and names of individual artists and against unhealthy interest in aesthetic quality alone. He wants to link art-history with geography, anthropology, and comparative religion; he would thus approach the Pre-Raphaelites as a source of information about the period in which they lived, stressing the group's relation to its surroundings rather than its internal complexion. This approach, where prehistory is concerned, becomes highly speculative, as the author readily admits; the adventures of Strzygowski and others are outlined in the chapter on comparative method. In the extremely interesting chapter on art and race, Professor Rice cautiously concludes that style can be associated with race in the "wide sense of the term," while concrete forms (subjects, motives, materials) appear to be correlated with race in the "narrowly anthropological" sense. On the relation of art to geography he is equally loth to dogmatize. He appeals for more mapping of the distribution of styles or of "the underlying ideas of arts," but concerns himself mainly with the influence of climate and relief on the origin of Palaeolithic and Neolithic art. He would not set geographical factors at naught—there is the recent example of Italian architects in eighteenth-century Russia—but is content to believe that if geography issues the challenge, it is man who reacts according to the stage of development which he has reached.

The book, though brief, is stimulating and speculative. The notes contain hints for further reading. The plates, though not numerous, are well chosen. J. P. H. M.

THE STORY OF THE LAMP (AND THE CANDLE). By F. W. ROBINS. *London: Oxford University Press*, 1939. $10 \times 7\frac{1}{2}$ *inches;* xiv+156 *pages; illustrations.* 15*s*

This book will be of particular appeal to those who are interested in the history of artificial lighting, and to them it will be a valuable book of reference. It contains a wealth of interesting information, the result of many years' research, while reference is made to specimens in the author's large collection and in one or other of some eighty other collections. The book deals with methods of illumination from Palaeolithic to modern times, from the fire to the high-power electric lamp, while reference is made to appliances in use in different countries, all of which are indexed.

Section I treats of fire, torches, splinters and rushlights, dips and candles, and candlesticks; section II of lamps, primitive and ancient to modern oil lamps, gas lighting, and the coming of electricity; section III of animal lamps, lanterns, miners' lamps, light-houses, and street lighting; and the Epilogue treats of the symbolism of light. It is well to be reminded that the first great change was the advent of gas lighting, which preceded the use of both colza oil and paraffin, and that paraffin lighting was not introduced long before electric light. There is a useful bibliography and fifty illustrations depicting nearly five hundred specimens. J. W. P.

GENERAL

LANDS BEYOND THE BORDER. By Dewan Bahadur H. L. Kaji. (*Bombay*): *Oxford University Press* (*Indian Branch*), 1939. 9×5½ *inches;* xii+220 *pages; maps and diagrams. Rs.*3

The title of this book gives no clue to its contents or purpose, and some such sub-title as "An economic geography for Indian students" would have been helpful. In addition to India's landward neighbours and all territories marginal to or within the Indian Ocean, it embraces the countries of the Nile basin, Soviet Central Asia, China, the Japanese Empire, and the Philippines. The book merits recommendation to those for whom it is intended; it is a well-written, adequate, and generally reliable summary of the facts of economic geography for these areas and includes numerous simple maps to assist the reader. The arrangement of chapters invites criticism; from the Arab lands one is taken to Nepal and beyond, as far as the East Indies, before being introduced to North and East Africa. Considering the scope of the book and its very modest size, errors of commission or omission are not numerous. 'Iraq's climate is defined as "Mediterranean" and southern Manchuria is stated to have a heavy rainfall. The scheme of natural regions for China is unsatisfactory. It is not always clear whether "Japan" means Japan proper or the Japanese Empire, and the common error that the former depends very much on imported foodstuffs occurs. Among a few misleading statements is one referring to Java as "a unique example of successful colonization of an equatorial region by white people." Traffic through the Suez Canal deserved notice in such a book, and after reading the preface one expected fuller discussions of Indian populations and interests "beyond the border." On p. 129 "altitude" should read "attitude."

A. V. W.

BEGINNING GEOGRAPHY IN AFRICA AND ELSEWHERE. By V. L. Griffiths and Abd El Rahman Ali Taha. *London: Evans Brothers*, [1939]. 9×5½ *inches;* 118 *pages; plans and diagrams.* 5*s*

This stimulating little book began as a course in elementary geography worked out by the authors for the use of their students in a teachers' training college in the Sudan. These students were preparing to give young African children their first ideas of geography and civics. The book has however a far wider application: the whole plan is based on two well-tried pedagogical principles, of proceeding from the known to the unknown, and of commencing geography actually in the classroom. The first set of maps made in class centres on the child's desk, the next on the classroom, the next on the school, and their ideas of scale and direction are instilled into the pupils. Journeys within and without the village are taken and mapped, and elementary ideas of civics are introduced by visits to local functionaries such as the postman, a local administration officer, a local irrigation engineer, followed up by appropriate work in class.

The book is arranged clearly and concisely, almost as a series of detailed instructions and hints to the teacher on the conduct of the course. Despite the limited scope however the general principles are so sound that teachers, whether in Africa, in Britain, or elsewhere, will quickly be able to apply them to their own elementary classes. Nevertheless the book is not simply a compendium which will relieve the teacher of the necessity of preparing his lessons. Whoever faithfully follows the prescribed course will probably find his labours considerably increased as a result, but that his pupils will benefit immeasurably is beyond all doubt.

S. H. B.

THE MONTHLY RECORD

DET NORSKE GEOGRAFISKE SELSKAB

The Norske Geografiske Selskab celebrated the fiftieth anniversary of its foundation in September last, and to mark the occasion has issued a much enlarged number of the *Norsk Geografisk Tidsskrift*. To this the President, Major K. S. Klingenberg, has contributed a paper recounting the course of Norwegian exploration from 1889 to 1939, and its close connection with the activities and development of the Society. The Society's foundation was inspired by the enthusiasm and interest aroused by the return of Fridtjof Nansen from his journey on skis across Greenland from east to west in 1888. It was natural that the Norwegians from their proximity to the North Polar region, and their long experience of ice navigation and of travel in Arctic conditions, should concentrate their exploratory and scientific activities largely upon the polar regions, and that their improvements in the technique of polar travel should be followed, and their advice sought, by explorers of other countries. When Nansen embarked upon his *Fram* expedition in the North Polar basin, the attention of Norwegians had already been directed to the south, and in December 1894 the whaler *Jason*, under Captain C. A. Larsen, reached 68° 10′ S., and a year later Norwegians landed at Cape Adare. Apart from the more spectacular achievements of Nansen and later of Otto Sverdrup in the Canadian Arctic, and of Amundsen, many Norwegian expeditions have carried out concentrated scientific work, particularly in Spitsbergen, Jan Mayen, and East Greenland. Early in the present century Norwegian scientific interest had been attracted to Spitsbergen, as evidenced by Professor K. Birkeland's Aurora expedition of 1902–03, and Major Gunnar Isachsen's expedition of 1906 to the north-western area; with the foundation in 1927 of the "Norges Svalbard- og Ishavs- Undersøkelser," directed by Dr. Hoel, research has been coordinated and extended. Of importance for meteorology have been the stations maintained in the Arctic, the first founded at Isfjord, West Spitsbergen, in 1911, and others at Bear Island, Jan Mayen, and East Greenland. In recent years outstanding achievements have been Amundsen's polar flights, the varied scientific investigations carried out on Amundsen's ship, the *Maud*, on her various voyages off the American and Siberian coasts under the direction of Captain Oscar Wisting and Professor H. U. Sverdrup, and the several voyages to the Antarctic by or on behalf of Consul Lars Christensen, in continuation of the work initiated by his father. Major Klingenberg justifiably stresses Norwegian cooperation with the scientists of other countries, which has produced valuable results. His paper, which forms a very useful guide, also shows how the fortunes of the Society have fluctuated with the achievements of Norwegian explorers, and it is gratifying to note that the Society embarks upon its second half-century with a membership of over twelve hundred.

INTERNATIONAL POLAR EXHIBITION AND CONFERENCE, BERGEN, 1940

We have received from Dosent Adolf Hoel, Chairman of the Norwegian Committee, the following *Intimation concerning the planned International Polar Conference at Bergen, Norway:*

In consequence of the state of war now prevailing in Europe, the International Exhibition for Polar Exploration at Bergen in 1940 has been temporarily postponed. It therefore naturally follows that the Polar Exploration Conference planned in conjunction with the Exhibition will have to be deferred until such time as the plans for the Exhibition can be realized.

RESEARCH ON HAIL IN FRANCE

In France hail is a climatic scourge and plays great havoc in the vineyards in many parts of the country. Hitherto attempts to divert the hail from the vines by shooting at the clouds have proved entirely unsuccessful because little was known about the process of formation of hail within thunder clouds. Latterly however more promising results on these lines have been obtained, and they are described by Professor André Allix, of the University of Lyons, in a paper entitled "L'étude de la grêle par avion et le système de défense du Beaujolais" (*Revue pour l'étude des calamités*, t. II, No. 5, 1939). The Beaujolais hills lie west of the Saône between Lyons and Mâcon, and consist of two parallel ridges, about 8 kilometres apart, stretching north and south. Upon a talus slope about 12 kilometres wide on the eastern flank of the hills grow some of the finest grapes in France. This district happens to be one of the most hail-stricken parts of the country. The storms, which occur most commonly on hot afternoons between May and September, originate in powerful ascending currents generated on the heated western slopes of the mountains and regularly follow the same tracks from south-west to north-east. The hail advances across the hills as a yellowish-white wall leaving behind a covering as thick as snow, and when it reaches the eastern side of the Beaujolais it falls on the vineyards in descending squalls, having an eddying or gyratory motion, which enhances its destructive power. The hailstones sometimes weigh a kilogram. In this, as in other districts, the formation of hail has been closely watched from aeroplanes, and a defence organization, supported by the Government, has been put into operation on the basis of the knowledge acquired. Hail commences to form near the summits of cumulo-nimbus clouds at their junction with a layer of cirrus or cirro-stratus, where the cloud particles consist partly of ice crystals and partly of water droplets in a super-cooled condition. In order that pellets of soft hail may grow into large hailstones they must be suspended within the thunder cloud for a time by powerful ascending currents and when the hail does fall it is localized in narrow bands a few hundred metres wide, small in comparison with the width of the whole thunderstorm. It is this localization of the hail which renders mechanical defence measures practicable. When a thunder cloud is sighted its physical condition is examined by airmen who then drop bombs on those portions where hail is observed to be forming, the agitation converting the super-cooled droplets into soft hail. Subsequently the cloud is attacked at the right points by mobile ground batteries, the effect of which is said to dislocate the rising air currents sufficiently to allow the soft hail to fall and melt before it has had time to grow. A fusible charge is used both in the bombing and cannonading so as to obviate the risk of damage on the ground. It is claimed that with the adoption of these measures in 1936 the wine growers of the Beaujolais have enjoyed complete immunity, whereas formerly they had to reckon annually with losses amounting to between 20 and 40 per cent. of the possible revenue.

Another interesting contribution to the study of hail in France is given by MM. C. Dauzère and J. Bouget in an article entitled "Sur la répartition des coups de foudre et des chutes de grêle dans le département des Hautes-Pyrénées" (*Comptes Rendus de l'Académie des Sciences*, t. 208, No. 23, 1939). The authors find that a correlation they had previously discovered to exist in the south-west of France between places frequently struck by lightning, geological formation, and places of origin of hail is strikingly verified in the department of Hautes-Pyrénées, one of the most badly visited districts of France. In this department a very dangerous belt of country for lightning, stretching from the Plateau de Ger to the Plateau de Lannemezan, is not only very frequently

ravaged by hail but also serves as a point of origin for hailstones affecting wide areas. When the wind blows from south-west in a thunderstorm embracing the whole region, and in a direction corresponding to the belt of country mentioned, a series of sensibly parallel ribbons of hail originate at diverse points above this belt. The town of Tarbes and the surrounding country sometimes gets catastrophic visitations as on 15 July 1927 and 7 July 1936.

THE AUASC AND LAKE ABBÈ

A recent survey of the Aussa region of Dancalia is described by Captain Giovanni Braca in *L'Universo* for March 1939. The writer was in charge of a mission sent out by the Istituto Geografico Militare in connection with the delimitation of the boundary with French Somaliland, and mapped the area on the scale of 1/100,000. The greater part of the paper deals with the lower course of the Auasc (Awash) and its termination in Lake Abbè (Abhebad). The inaccuracies of earlier maps, particularly of the 1/400,000 map of Eritrea, are strongly emphasized. The survey showed that Lake Abbè has formerly been shown too far south and much smaller than it actually is, its area being over 500 square kilometres, and that the Auasc does not end in the swamps of Aussa, but ultimately enters this lake.

In dealing with the few explorers who had entered this region, the writer remarks that no one had determined the lower course of the Auasc, for L. M. Nesbitt, who reached in 1928 the point where the river enters Aussa, was prevented by the Sultan from continuing farther. The writer however has overlooked the journey of Mr. Wilfred Thesiger in 1933, described in the *Journal* for January 1935, during which he followed and mapped the lower Auasc to its entry into Lake Abbè. Given the difference between the opportunities of the two parties, there is quite close correspondence between the two surveys, and it is clear that the main features of the hydrography of this region were correctly determined by Mr. Thesiger. Instances where they differ can sometimes be explained by seasonal changes. There are also, as might be expected, some differences in the nomenclature, for example where the name given by one party to a lake is applied by the other to a neighbouring mountain. The Italian party do not seem to have visited the north-eastern shores of the lake, along which Mr. Thesiger was able to travel.

In accordance with a recent decision of the P.C.G.N. to recognize the forms of names officially used by the governments of foreign countries (*Geogr. J.* 91 (1938) 158), we have given priority to the Italian forms Auasc and Lake Abbè. The sheets of the official 1/M map of Italian East Africa and the official 1/3M map of Libya are covered with familiar names, which, though carefully transliterated from Amharic, Arabic, etc., have now an unfamiliar form. The form Auasc, in which the final *sh* sound, practically unknown in Italian, is represented by the device *sc*, and the vowel *u* is made to serve as a consonant, which is equally foreign to Italian, illustrate the difficulty of writing North African names in Italian form.

GERMAN SCIENTIFIC RESEARCH IN NORTH-EAST AFRICA

Results of some importance have accrued from the researches of German travellers in Eritrea and Ethiopia between 1933 and 1937, a general account of which is begun in *Petermanns Mitteilungen*, July–August 1939. The work was started in 1933 by Dr. Carl Troll, well known for his geological and other researches in the Andes and Himalaya, who in company with Herr K. Wien (since dead) began investigations into the climate, plant-geography, and colonial-economic question in this part of Africa; but owing to the critical

position in Abyssinia work had then to be limited to Eritrea. After an interval during which he took part in the German Himalayan expedition, Dr. Troll returned to his African task accompanied by Dr. R. Schottenloher, who is jointly responsible for the present summary. Dr. Troll entered the field by way of Massaua, chosen as the nearest point on the coast to the highlands of northern Ethiopia, with their chief centre at Asmara. Already round this town Dr. Troll could study the red tufa formation which occupies considerable areas, forming terraces at varying elevations; this, contrary to previous belief, he showed to be not due to decomposition of the old crystalline base of the region, but to represent the lowest member of the extensive eruptive series (late Cretaceous and Tertiary) to which the widespread basalt of the region also belongs; the terrace formation was found to be due to faulting. Particular attention was given to the complex climatic conditions, to which existing data gave an insufficient clue. Here the results are valuable as bringing the climate into detailed relation to the surface features. The areas and varying amounts of summer and winter rains—with an intermediate belt of rain during both half-years—are clearly defined in a pair of sketch-maps. While summer rains characterize the uplands, reaching a total of over 600 millimetres over considerable areas, a belt of winter rains over the coastal belt, and their distribution, is governed by the daily swing of air between the Red Sea and the highlands. The highest degree of cloudiness occurs in general along their escarpment, and here, in a climate productive of tropical high forest, coffee planting reaches its northern limit in Africa. An intensive study of the vegetation helped to fill gaps in the climatic data while at the same time bringing out the general relation of the plant formations to the climate, geology, and surface features, which is illustrated by a series of instructive sections along the lines of route. The paper records briefly the results of journeys carried out in 1937 from Asmara to Gondar; from Asmara to Addis Abbeba; and from the last to Harar. A section treats of the economic conditions, special stress being laid on the Italian road-making, which is opening up the country in belts along the main routes. In this connection it is of interest to record the completion, recently reported from Rome, of the strategic road from Assab to Dessiè, supplying an independent line of access to Ethiopia across the Danakil desert. Dr. Schottenloher continued the research alone in 1937–38, and will report his results in a later issue of the *Mitteilungen*. A complete series of scientific memoirs is in preparation.

E. H.

EROSIONAL EFFECTS OF NEW ENGLAND HURRICANE, SEPTEMBER 1938

The account of the great hurricane given by Dr. C. F. Brooks in the *Geographical Review* for January 1939 (*Geogr. J.* 94 (1939) 89) is followed in the April number by a contribution from Mr. H. H. Bennett entitled "A permanent loss to New England: soil erosion resulting from the hurricane," and in the July number by two further articles respectively by Mr. A. D. Howard and Mr. C. W. Brown on "Hurricane modification of the offshore bar of Long Island" and "Hurricanes and shore-line changes in Rhode Island."

Mr. Bennett points out that in the Connecticut valley, Massachusetts, Vermont, and the coastal plain of New Jersey, erosion due to the hurricane was so severe that vast quantities of productive topsoil, sluiced into the streams and rivers, are gone for ever. Damage to fields ranged from deep gullying to the removal of an inch or more of topsoil more or less evenly from entire fields. The latter type of erosion, described as "sheet washing," resulted in growing crops of all kinds being washed out of the ground and carried along with the

soil. In other places crops were buried under deposits of sand, mud, and gravel spread out over lower slopes and bottom lands by floodwater. Observers in the field state that wind, water, and soil all travelled together, and that in some places soil was actually moved uphill over gentle slopes and across divides to be washed away into streams on the leeward side of the crest. In many places grooving or striation of the surface soil in the direction of the wind is said to have been observable.

It is estimated that the rainfall figures (in some places amounting to 8 inches for the five days of the storm), which ordinarily would be used to indicate the intensity of precipitation, should be "at least doubled in order to express the force of this wind-driven sheet of water." What precisely this comparison means is far from clear, but the movements described are of great interest from the analogy with drifting snow. In severe drifting snowstorms leeward slopes and valleys are apt to receive great accumulations at the expense of windward, and the phenomenon raises theoretical difficulties concerning the meaning of meteorological precipitation over particular areas in such circumstances. It is feared, as a further untoward consequence of the New England hurricane, that the newly formed erosion channels will enhance the risk of future flooding.

Mr. Howard summarizes the changes effected by the storm in the Long Island bar as follows: formation of new inlets; destruction of sand-dunes; development of shore-line irregularities; and lateral growth of the bar through accumulation of sand behind the dune line. The modification of the bar appears so to have disturbed tidal conditions in the bays behind it that some areas, formerly beyond the reach of even the highest tides, are now periodically flooded. The breaching of the bar in September 1938 along a 50-mile stretch of almost unbroken continuity, especially opposite Shinnecock Bay, is attributed to a number of very high waves associated with gusts of wind of over 100 miles an hour as described by Dr. Brooks.

In describing the shore-line changes wrought by the hurricane in Rhode Island Mr. Brown emphasizes the fact that wave erosion and tidal scour proceed very swiftly in a higher weaker zone not usually affected by ordinary waves. In the present case recession of the coast-line at the higher level seems to have amounted to as much as 40 feet in a few hours—a much greater recession than could be effected by ordinary wave action in a century.

MEETINGS: SESSION 1939–40

First Meeting, 30 October 1939. The President in the Chair

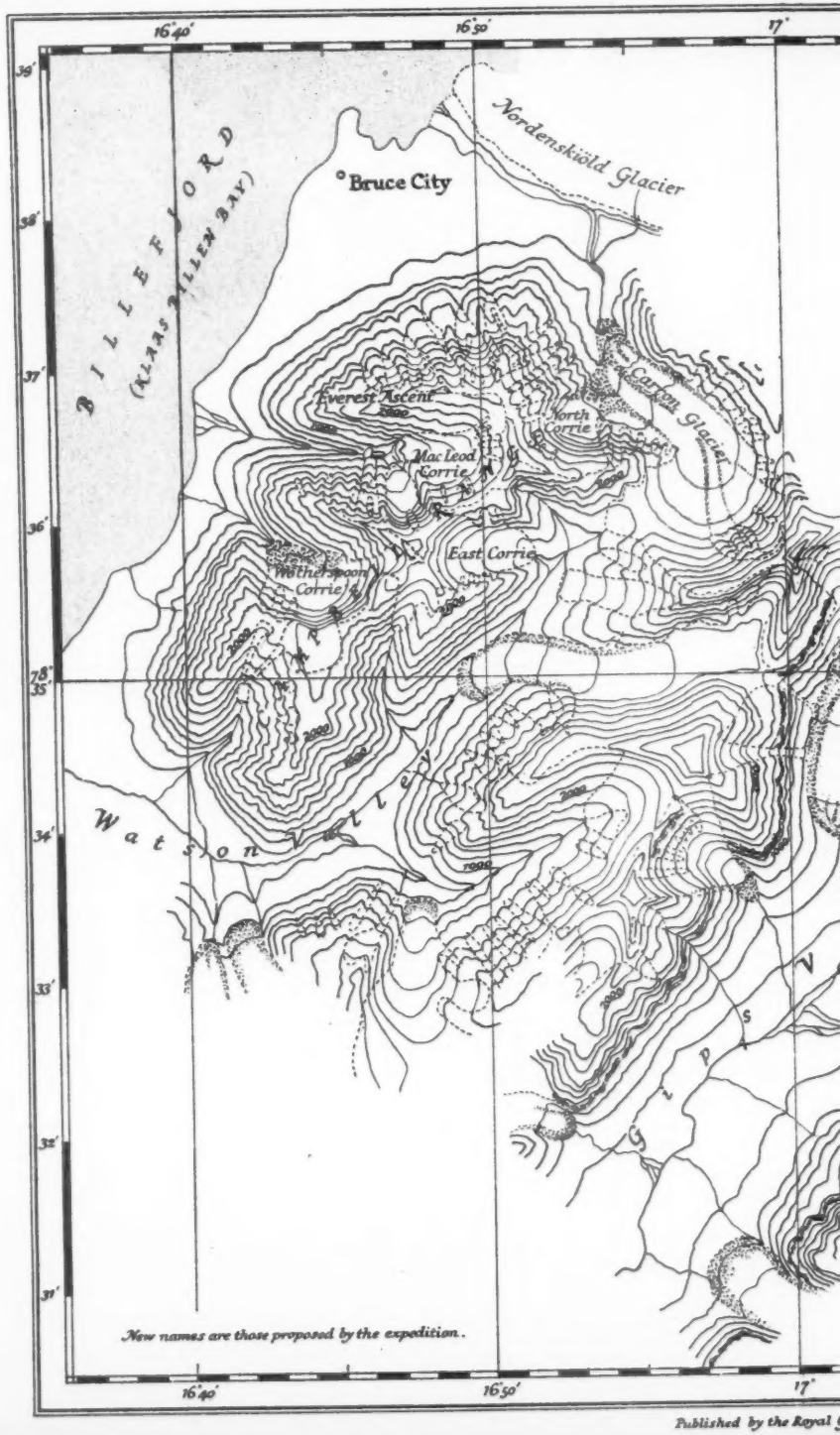
Paper: Six months in the Assam Himalaya. By Mr. F. Kingdon Ward

Second Meeting, 6 November 1939. Mr. W. L. Sclater, Honorary Secretary, in the Chair

Paper: Formal writing on maps. Discussion opened by Professor C. B. Fawcett

Third Meeting, 13 November 1939. The President in the Chair

Paper: Madagascar in 1939. By Dr. C. R. Porter



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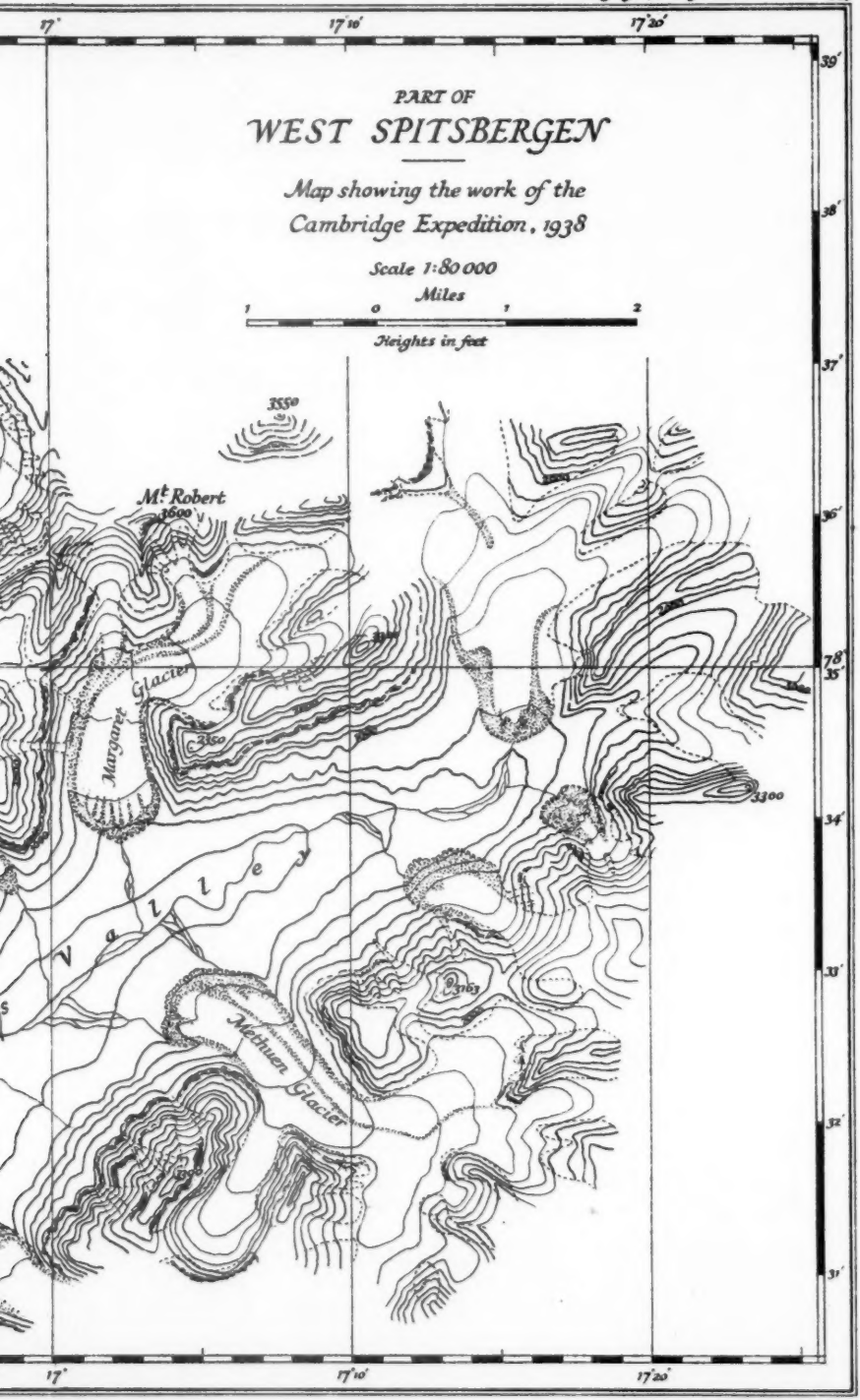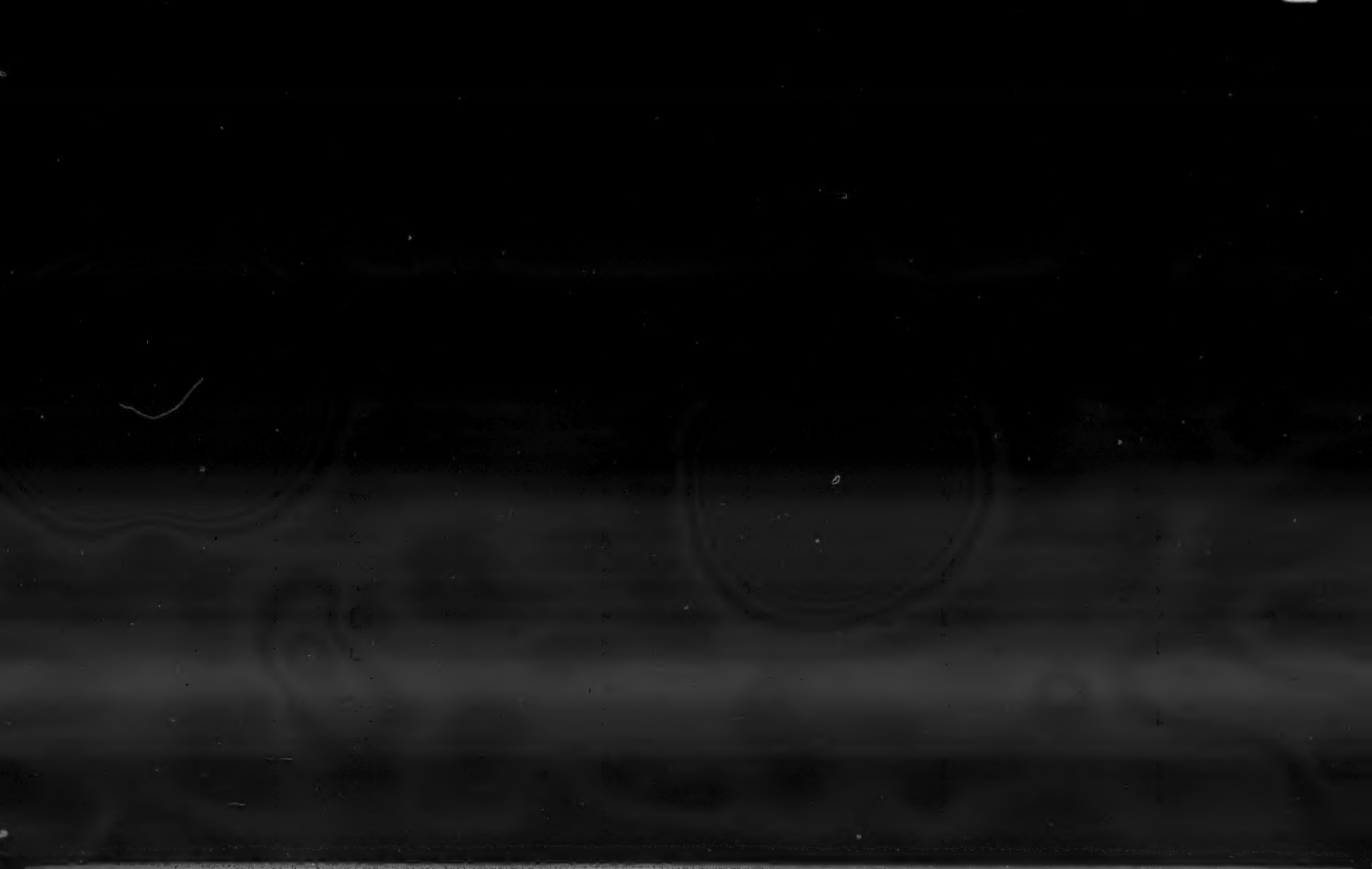
17°
17° 10'
17° 20'
39'
38'
37'
36'
78° 35'
34'
33'
32'
31'
PART OF
WEST SPITSBERGEN
Map showing the work of the
Cambridge Expedition, 1938
Scale 1:80 000
Miles
1 0 1 2
Heights in feet
3550
Mt. Robert
3600
Margaret Glacier
3100
3300
Valley
Methuen Glacier